GAS JOURNAL

VOL. 261. No. 4529 102ND YEAR MARCH 22, 1950

A NEW DISEASE?

THERE is nothing new about the element of frustration. Irrespective of age everybody must feel from time to time that his claims for recognition are not being met as they should be met and that his talents, skill, experience, and the like, are being tramelled, or systematically and viciously ignored and neglected. Since nationalisation of the gas industry, however, we have heard a great deal more than ever before about frustration within its ranks, of time lost through unnecessary form-filling, of dampened enthusiasm, of chilled effort, of bureaucratic method. In an address to the Northern Junior Gas Association, published in our issue to-day, the Chairman of the Northern Gas Board, Mr. Edward Crowther, tackled this problem from board level and asked whether this frustration business—*i.e.*, the attitude of the 'frustrated'—was justifiable or whether it was in the nature of a new and insidious disease (virus nationalisation *per se*). The thought passed through his mind, though he quickly dismissed it, that frustration might be the feeling experienced by an individual on first realising that, though engaged in a nationalised industry, he is still expected to do some work. And Mr. Crowther passed on to the explanation that the attitude was the outcome of misunderstanding of a common purpose. It should be recognised, he argued—and surely he is right in this—that a gas board which has to formulate administrative policy and plan schemes of integration and whose area comprises many undertakings both large and small, in urban and rural areas, must as a first step collect the necessary complete information about each individual unit. No plans could be laid other than on the basis of reliable data which can be translated and analysed at board level; and in effect he asked the personnel of the Northern area to see this point, to exercise patience, and to co-operate to the full. The information sought, he emphasised, was sought not to frustrate the individual but to develop gas service throughout the area and in so doing raise the status of the man on the spot and in general to provide greater opportunities.

The opportunities are there to visualise. A gas grid is envisaged which will eventually cover an industrial belt extending from north of Blythe down to the southern boundary of the board's territory, and some 20-30 miles in width. On the westerly side of the board's territory the local gas grid based on Workington is to be extended to cover West Cumberland. Construction of new gas-making plant is proceeding at several centres. As in other gas areas, 1952 will witness the fruition of much good work in the Northern area. This is the broad outlook; success will depend on harmonious working relationships, delegation of authority and responsibility, and absence of the frustration element. 'A conception of responsibility and of instructions and its understanding by every individual engaged in a joint enterprise are essential to success.' We quote Mr. Crowther, who made a major point of the fact that responsibility cannot be concentrated in a few senior executives. On this question, while explaining the policy of the Northern board, he had a good deal to say which should encourage junior gas engineers in the area. He assured his audience—a record gathering—that the juniors' welfare is a prime factor among the board's consultations, among the aims being to provide means whereby young men of ability and character may most readily progress from manual to technical and from technical to management duties as they show themselves capable of being advanced in their own interests and in the general interest of the gas industry.

DESIGN FOR SELLING

IN the November 9, 1949, issue of the *Journal*, we published the Presidential Address given by Mr. J. H. Dyde to the Southern Association of Gas Engineers and Managers in which he described the administrative plan of the Eastern Gas Board, of which he is Deputy Chairman. Although necessarily limited in scope, this address constituted one of the most detailed outlines of policy to be made known by any area board. Dealing with characteristics of the area, machinery for control, and plant development, the address covered but half of the picture—the first half. Plans for integration, decentralisation, and the modernisation of manufacturing plant cannot be made without a careful examination of the effect of these changes on the sales and service organisation. It is, therefore, not surprising to learn that Mr. Dyde took up the story where he left off, and, on February 14, addressed 100 salesmen at Luton. His audience constituted the newly-formed Eastern Area (Wat-

ford Section) Gas Salesmen's Circle, which made its debut on January 4 and, with the Tottenham Section and the Norwich, Ipswich, and Cambridge Section, makes up the trio of Circles in the area of the Eastern Gas Board. His talk was refreshing in that it clearly indicated something of the pattern to be followed in building up, balancing, and maintaining an effective sales organisation in this area. As such, it serves not only as a guide, but as a goal, for those whose task it is to mould future sales activity in the gas industry, no less than for those contemplating giving a serviceable account of policy to their subordinates.

Mr. Dyde commenced by outlining the position as the board found it at vesting date, a state of affairs in which there was a wide variation in on-costs, an only partial reversion to hire-purchase selling, a number of uneconomic rental terms, and little uniformity regarding fixing charges. The machinery set up to level out these variations and develop a uniform, economic scheme was the Area Sales and Service Committee, which comprises the five divisional sales and service or commercial managers, with the Area Deputy Chairman as Chairman. In attendance at this committee, which meets monthly, are the specialised industrial gas salesmen, the coke adviser, and the publicity officer, who represent area interests on the respective national committees. Aided by this committee, the board has developed policy along a number of channels, chief among which is a quest for uniformity. Only in the Metropolitan part of the area—*i.e.*, that which formerly came within the London Regional Domestic Committee of the British Gas Council—was there to be found a measure of uniformity of policy, and in bulk of sales and population served, this represented a not unappreciable portion of the area. Although the margin of profit on sales was somewhat higher than had hitherto been applied in many of the provincial areas, an analysis of costs that had to be carried by the physical process of selling showed that the margin was none too great. At this point, Mr. Dyde interpolated to remark that while the cost at which gas is sold should rightly carry a reasonable figure to cover consumer's service, it was not considered desirable that it should be loaded further with the many costs of the sales department, such as salaries of salesmen, publicity, transport, &c. The board's view, therefore, was that the general run of appliances should carry on-costs to the extent that they would cover selling costs. It was therefore decided to frame general selling terms on the former London Regional price computation, and to extend hire-purchase on an approved list over three and five-year periods: this, of course, brought Eastern policy into line with that of the North Thames, South Eastern, East Midlands, and West Midlands boards.

It is of interest to note the Eastern Gas Board's reaction to the challenge of new housing which, since it is intended for what may be broadly termed 'the working class,' necessitates the provision of a modern cooker at the lowest possible price. Two types of cooker were selected, which because of mass production and bulk purchase were obtainable at a reduced price. Not only has this reduction been passed on to the consumer, but the profit margin has also been reduced. In due course it is hoped to eliminate the practice of simple hire, although this practice is being continued to meet existing local conditions. Water heaters and space heaters, which labour under the yoke of a two-thirds tax, are sold in such a way that the tax is accommodated in the initial payment, the remaining cost being allowed to spread on hire-purchase terms, with the fixing charge, determined by estimate, as an extra.

Mr. Dyde described other matters which have been considered by the Area Sales Committee, such as the partial or complete standardisation of discount rates for bulk buying, on-costs to labour in the estimating and charging for work done, forms used in connection with gas supply, and forms of agreements for public lighting. In particular, much thought has gone into a study of contributions towards the cost of estate mains, services, and internal supplies to new housing. Mr. Dyde pointed out that whereas electricity and water have an assured revenue, gas remains a fuel relying for its use on the preference rather than the necessity of the consumer. The electricity boards now lay their mains and services free of charge, a method less easy for gas. Referring to new housing, Mr. Dyde remarked that in a number of rural areas the costs of taking gas to the point of consumption was so uneconomic that the field had to be left to their electrical competitors. 'When the boundaries of our area were determined,' he said, 'it was realised that many small undertakings in rural areas were no longer economic units and that development in those areas would prove a costly proposition. For that reason the area as a whole was given an urban backing. There is a limit, however, to which built-up areas can subsidise scattered development of rural areas, and in our case it may well be argued that the extent of our urban support is inadequate.'

POOLING OF RESOURCES

A STUDY of Mr. Dyde's address clearly shows his determination to explain the necessity for regarding the area as a whole—a difficult accomplishment for most of his audience, whose interests were inevitably anchored to their individual positions. He was at pains to describe how certain facilities, hitherto available only in one section of the area, must now be extended for the benefit of all. In the field of display and publicity, there can be little doubt that Watford and Tottenham constitute the principal points of development, and it is not surprising to learn that the services offered by these two undertakings are to be so fashioned as to reinforce existing facilities elsewhere in the area. On this subject, Mr. Dyde remarked that as undertakings, both large and small, were now knit more closely in common policy, there was not the same need for concentrating so much work in a central organisation. 'I do not mean to imply,' he said, 'that a central body is not essential for co-ordinating and publicising national policy, and maintaining national prestige for the industry, but publicity to be most effective must be directly linked with organised selling campaigns at local, divisional, or area levels.'

Similarly, a pooling of resources may be employed in such a way as to utilise experienced district representatives as mobile or itinerant salesmen. Mr. Dyde revealed that already parties of salesmen have been sent out to comb

districts that have hitherto never experienced a planned selling campaign, but that the general idea was capable of considerable expansion. He made the proviso, however, that it would be unwise to adopt these tactics in those districts where variable gas pressure and quality, deficiency of supply, and poor service have undermined consumers' goodwill. He added: 'There are instances, I am sad to say, where nothing short of a bulk supply to give an arterial infusion through the whole of the existing supply system will achieve the objective we desire, and this again is a matter of time.' As an example of the type of integration planned, Mr. Dyde instanced a case in Essex where a transmission main linking two medium-sized works about 20 miles apart will enable manufacture to cease at four smaller works and give a first supply of gas to a number of villages; he anticipates doubling the present consumption when proper supplies are available. Referring to inadequate showroom facilities in some parts of the area, Mr. Dyde stated that in Suffolk the board is experimenting by making local ironmongers selling agents—a principle which was being developed successfully in the London area in pre-war days. Finally, the author touched briefly on the district heating bogey—remarking that the threat from this source had, for the time being, been expelled—and to the 'powerful appeal' of the immersion heater. He suggested the gas attachment designed for use with the Fulham finned back boiler as a first competitive counter.

It is clear from the address that plans are well ahead for the development of this extremely uneven area. That in itself is creditable and encouraging; what is even more commendable is the fact that these facts are being properly explained by the board to the employees, whose whole mode of work is affected. In the course of his address, Mr. Dyde emphasised his support of several selling aids which the *Journal* has long endorsed. Chief among these is the necessity for the Salesmen's Circles to continue to play their part with a minimum of interference (or 'guidance') from above. Moreover, he clearly recognises the value of Home Service, on which he commented: 'We have made a survey of the number of home service advisers operating within the area, as we think highly of the type of service they can render, and while two divisions are quite adequately served, the others extending into the rural areas need reinforcing.' Mr. Dyde also made specific reference to films which he termed 'an excellent advertising medium when properly used.' These are not small points, because they reveal the broad approach being adopted by the Eastern Gas Board, which embraces all the means by which general sales and service may be improved. It is, we suggest, only by this combination of decisive action with a tolerant and sympathetic understanding of the well-being of its employees that the gas industry will continue to expand and prosper.

MINERS ON THE MOVE

THE continuing drift of manpower away from the mines can no longer be regarded with equanimity. During the first nine weeks of this year the number of miners employed has dropped sharply by almost 4,000, a rate of decrease which hardly tallies with Lord Hyndley's New Year forecast, reported in the *Journal* of January 26, that the year would close with about 700,000 men on the books. This estimate allowed for a drop over the whole year of just under 9,000, but in little over two months we have seen almost one-half of that total decrease take place. Much of the decline so far this year is unquestionably the result of the lifting on January 1 of the 'ring fence' round the industry, by which workers over 18 years of age were not permitted to leave the industry. It is at the same time, however, a direct continuation of the fall in manpower which was so disturbing a factor in the industry throughout 1949. From a record post-war total of 726,900, at the beginning of 1949 the figure steadily crept down to 708,900 at the end of the year, and now stands at 705,200.

At various times last year we drew attention in these pages to the manpower problem, criticising in particular what we considered to be a complacent attitude on the part of the National Coal Board towards both the drift away and the low rate of recruitment. The reluctance of the N.C.B. to take any extraordinary measures to combat what we described in the *Journal* of October 12 as a potential manpower crisis may be explained in part by the fact that the effects of a lower labour force have been more than offset by increased production achieved by greater mechanisation, schemes of integration, and improved output per manshift. Such an attitude of mind is, we believe, only concerned with short term results—an approach which has bedevilled the mining industry throughout its long history.

When the 'ring fence' was removed, it was hinted that the main effect would be to remove the less productive workers from the mines. It was also hoped, however, that it would encourage into the industry potential new entrants who had previously been deterred by the prospect of committing themselves for an indefinite period. Productivity so far has shown little change; both the overall output per manshift and that at the face have remained unchanged, apart from minor fluctuations, at 3.11 tons and 1.2 tons respectively since the beginning of the year. Neither is there at present any indication of increased recruitment to swell the depleted labour force. But the most disturbing factor is that 2,700 of the 3,700 men who have left the pits this year are workers at the face. However rapid the mechanisation of the mines may be in the near future, the National Coal Board must face a growing danger of stagnation through a lack of skilled labour to operate the machines at the coal face.

COST TO THE CONSUMER

WE have become so accustomed, and even hardened, of late to reports announcing increases in the price of coal, gas, and electricity for the domestic consumer that it comes as something of a surprise to learn from so reliable a source as the Ministry of Labour that the index of retail prices for fuel and lighting rose only 1% during 1949. The Ministry estimates that as a result of increases at various times of the year, which affected about two-fifths of the areas covered by the enquiries, the average level of charges for domestic supplies of gas rose by about 3½% last year. The retail price of household coal rose by approximately 2½%, due mainly to the higher

prices in a number of areas which followed the revision of pit-head price structures at the end of May, while coke prices remained virtually unchanged throughout the year. The varying charges for electricity complicated the picture at all times; a decrease of 2% in the index recorded in March as a result of the seasonal fall in electricity charges introduced at the end of the year, together with the higher prices for coal and gas, produced the final increase of 1% by the end of December.

IDEAL HOME EXHIBITION

THE Ideal Home Exhibition, which is currently attracting large crowds to Olympia, was the subject of a detailed review in last week's *Journal*. In this, particular mention was made of the Gas Council stand which devotes a considerable part of its area to six tableaux depicting scenes from the Walt Disney film, 'Treasure Island.' In our comments we implied that last year's 'Alice in Thermland' display also owed its derivation to the Disney Studios. This was not the case, and we regret our error. In fact, the tableaux were based on drawings by Arthur Rackham, and were adapted by the Gas Council as a result of negotiations with the publishers, William Heinemann, Ltd.

THE INSTITUTION MOVES

THIS week marks an important milestone in the history of the Institution of Gas Engineers. On Monday last the library, committee rooms, and administrative offices of the Institution moved from Gas Industry House to 17, Gosvenor Crescent, the long lease of which the Institution has been enabled to purchase out of the Building Fund contributed for the purpose by its members and by gas undertakings and manufacturers of plant and appliances. We have had the opportunity of visiting the new headquarters, which were the subject of an editorial note in last week's *Journal* (p. 636), and we were greatly impressed by the fitness for purpose of the new premises. Members and all concerned, we feel sure, will be high in their praise of what has been carried out—all in keeping with the status, the growing status, of one of the foremost engineering institutions in the country; and we may add that the furnishing is in the best of taste. The Council of the Institution proposes to arrange for the new headquarters to be opened officially early in May, when we shall publish an illustrated description. Now, however, 17, Grosvenor Crescent (telephone number unchanged, SLOane 8266), is being used for all Council and committee meetings of the Institution; and the library, reading room, and members' room are open for use by any member of the Institution.

SHORT PAPER MISCELLANY

THE London and Southern Junior Gas Association has had two short paper evenings during the present session. The first was substituted at short notice for a paper whose author had died since the compilation of the syllabus. The second, on March 10, was well filled with four good contributions, and although the discussion was slow in warming up no fewer than 13 members and visitors had participated before the four authors were called on to reply. The papers by R. F. Hayman on 'A New Design of a High Temperature Natural Draught Furnace' and E. A. K. Patrick on 'New Refractories and Insulating Materials' were to some extent related, both being based on high temperature research work carried out at Watson House, to whose late Manager, Mr. W. Dieterichs, each paid tribute before giving his paper. The other papers —one by L. J. Collins (Luton) on 'Use of Steam Ejector as an Aid to Dry Purification' and the other by J. E. Cooper (Potterton Gas Division, De La Rue, Ltd.) on 'A Novel Application of Gas'—came from two entirely different angles of the industry. The whole bill of fare was refreshingly interesting in its variety, but it was too unwieldy to permit of concentrated discussion on any one subject. Mr. J. D. C. Woodall (Maidstone), who presided in the absence of the President, Mr. A. H. Savill (Wandsworth), showed a right appreciation of human nature in ruling that all four papers should be given in succession and that the discussion should be an informal conversation on all four subjects. Only in that way could he ensure that each author should have his due. Not all the papers called for a uniform amount of debate; for instance, Mr. Cooper's talk on the use of gas in bottle washing was so well illustrated with lantern slides that there was little to be added by way of question and answer. We hope to publish all four papers in the course of the next two or three issues of the *Journal*. The first, that by Mr. Patrick, appears on p. 711.

Letters to the Editor

NEW RECORDS AT NEWCASTLE

DEAR SIR,—You may be interested to learn that some very considerable figures have been achieved by the Newcastle Division in respect of maximum makes and deliveries during the winter just ending.

The division's maximum day in so far as deliveries are concerned amounted to 57.888 mill. cu.ft., while the maximum week's delivery was 385.850 mill. cu.ft.

Your readers may be interested in a rather significant change which appears to have taken place in our demand during this winter. Normally we expect fairly sharp temperature drops, but expect them to be of relatively short duration. This winter, however, we have had prolonged spells of the type of weather conducive to heavy gas consumption, and we have on record a period of seven consecutive weeks in which the daily demand averaged 53 mill. cu.ft.

Yours faithfully,
JOSEPH E. WHITE.

Northern Gas Board (Newcastle Division),
30, Grainger Street,
Newcastle-upon-Tyne, 1.
March 15, 1950.

MATERIAL HANDLING

DEAR SIR,—In your Editorial comment in your issue of February 22, on Mr. Moy's paper to the Southern Association of Gas Engineers and Managers, you speak of 'brutal methods of the bulldozer and tipping lorry.' May I make the following points.

In trimming coal by bulldozer it should be remembered that coal has generally to go through the crushers on the way to the retort house and that the use of the bulldozer gives a more homogeneous mixture in the heap.

Furthermore, this machine is so versatile that it can be used for many other jobs on the works, such as breaking and trimming oxide, trimming breeze, levelling sites and, with suitable attachments, for loading materials on to lorries, digging trenches, and handling and laying pipes.

When building coke heaps by tipping lorry there is interposed between the coke and the lorry wheels a semi-flexible demountable steel road, and crushing of the coke is negligible. Furthermore, the work done against gravity is done in large units—*i.e.*, lorry loads—by a number of separate prime movers which are standard and for which spares are easily obtainable.

I make this contrast, of course, with stacking devices such as portable conveyors, cranes, &c., which rely on a single prime mover and on a system of ropes or drives for which spares are probably somewhat specialised.

Yours faithfully,
H. M. LAWRENCE,
General Manager.

Portsmouth, Gosport, and Bognor Regis Gas Undertaking
(Southern Gas Board),
The Square, Portsmouth.
March 14, 1950.

ECONOMICS OF GAS PRODUCTION

DEAR SIR,—I have carefully perused Mr. Hawthorn's letter in the current *Gas Journal* and am pleased that we are in agreement with regard to the evils of producing blue water gas in vertical retorts beyond the capacity provided by the sensible heat in the discharged coke, but on other points I must dispute his claim that maximum gas production can be obtained by leaving benzole in the gas to carburet diluent gases. In my letter to the *Gas Journal* of March 1, I suggested that an extra 12% increase in thermal output over and above that obtained

when benzole was left in the gas was possible by producing low quality gas in verticals and carburetting the purified gas with petrol, a proposition which I put forward as a logical sequence to the absence of benzole recovery. Incidentally, there would be a considerable reduction in coke for sale due to the reduced coal throughput necessary to produce the low grade gas.

Why does Mr. Hawthorn deprecate the production of extra coke when benzole recovery is practised? All increased sales of gas carry with them increased coke production unless carburetted water gas is made the sole medium to meet expanding business. The whole question seems to resolve itself into the problem of whether it is justifiable to ignore economics when peak demands for gas have to be met.

Another point which Mr. Hawthorn underlines in his letter is that in his experience increased coal throughput in verticals is associated with increased calorific value. Is this due to the reduction in steaming and consequent higher retort temperatures rather than to any lowering in retort temperatures due to increased coal throughput?

In horizontals the highest calorific value gas is obtained on the low throughputs; here there are no complications due to steaming.

Yours faithfully,

F. FIRTH.

Laboratory,
Meadow Lane Gasworks,
Leeds 11.
March 17, 1950.

AN HISTORIC MOMENT

DEAR SIR,—I should like to put on record an event which took place in the early part of the present century, at a time when gas was made to the candle-power standards and when cannel coal was becoming in short supply. Carbonisation in vertical retorts was receiving much attention. The year 1902 had seen the Settle-Padfield experiments; 1904 had seen the success of the German Dessau intermittent vertical retort; during the period 1904-08 there were the experiments of West and of Woodall-Duckham on continuous verticals, and of Robert Dempster on intermittent verticals.

About 1907, when reliance was placed on refractory cones for judging carbonising heats, pyrometers not then being known in retort houses, Mr. J. W. Broadhead, of Robert Dempster and Sons, Ltd., came into the drawing office and said that there was a cloud on the horizon—that the German vertical retort was coming to Britain. The firm had taken out a patent for a setting to heat intermittent vertical retorts, and he called on the drawing office staff to throw themselves into the work of development. It fell to me to be responsible for all mountings.

It was soon found that the Germans, with their thoroughness, had already patented all parts with British patents (and patents pending). However, by hard application, the trial setting was ready for work in 1908 at the Cleethorpes gasworks. The German syndicate immediately claimed that we were infringing their master patent—a patent of which we had no knowledge. The master patent claimed: 'Subjecting coal in a vertical retort, heated to a higher temperature than usual, whereby the gas was forced inwardly to ascend the cooler core of the charge, by which certain advantageous results were obtained.'

Here was a formidable case. If the German syndicate won its case, then all development in Britain of continuous or intermittent vertical retorts would be impossible except under royalty. The German syndicate threatened to attack Dempster's, and an expensive patent law case was in the offing. The Cleethorpes plant had only just started work. We adopted the advice of the firm's Patent Agent (Mr. E. P. Newton, of Fitzwilliam House, Richmond) to continue to work the experimental bed at Cleethorpes but to keep the carbonising temperature at a normal degree, collecting data as to the resulting products. Professor Bone and his staff from Leeds University analysed and tabulated the products. The Germans speeded events by obtaining a Court injunction to inspect our plant at Cleethorpes. The day came for the syndicate's inspection, the appointment being arranged for 9 a.m. I was present with the gas engineer, Mr. J. E. Brockway, but the German representative was late. At 9.30 a.m. a taxi drew up containing many instruments, including pyrometers. Evidently measuring temperature was to be the keynote of the visit. An amazing incident then occurred. Mr. Brockway, looking solemnly at his watch, accused the representative of failing to keep his appointment, emphasising that the appointment was a legal one for 9 a.m. and though we had kept it according to the law the German had not, and that therefore the matter was at an end as he had other appointments to attend. He called for his car and left immediately. The representative found the gasworks gates closed against him and he returned to Germany with information *nil*.

Subsequently we heard no more of the matter. Mr. Brockway's action gave to Britain the unfettered right to develop vertical retort carbonisation, both continuous and intermittent. The amazing development of vertical retort carbonisation which has since occurred owes more than is realised to this historic moment.

Yours faithfully,

H. J. TOOGOOD.

43, Uxbridge Road,
Hampton-on-Thames.
March 15, 1950.

Personal

Mr. **G. C. Gould,** F.R.S.A., Member of the Sales Managers' Association and of the Institute for Export, has been appointed by William Sugg and Co., Ltd., Westminster, as Sales Manager. Mr. Gould served in the Corps of Electrical and Mechanical Engineers from 1940-47 and saw service in India and Burma. During this period he held the appointment of Deputy Assistant Director of Mechanical Engineering.

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Mr. **H. J. Nichols,** C.I.E., D.SC., M.I.C.E., A.M.I.MECH.E., has been appointed Registrar and Secretary of the Professional Engineers Appointments Bureau in succession to Mr. R. W. L. Harris, whose retirement was announced last week.

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Councillor **W. Hughes** (Little Hadham) has been appointed a member of the Eastern Gas Consultative Council. Mrs. **D. N. Rathbone** (Oxshott), a member of the South Eastern Gas Consultative Council, has been appointed Deputy Chairman of the South Eastern Council.

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Mr. **T. S. Ricketts,** Group Engineer of the Hitchin Group, Watford Division, of the Eastern Gas Board, was recently appointed Assistant Distribution Engineer to the Wales Gas Board. Mr. Ricketts, who was a pupil at Hertford Grammar School, entered the industry in 1931 as a junior chemist at the Hertford works, later becoming Technical Assistant and then Works Engineer. He left Hertford to take up his post as Works Engineer at Hitchin in 1947.

Diary

Mar. 25.—London and Southern Junior Gas Association: Visit to Wandsworth gasworks.

Mar. 28.—Southern Association of Gas Engineers and Managers (Eastern District): 'Practical Aspects of Design and Construction in Gasworks Installation,' S. C. Herbert (South Eastern Gas Board). Gas Industry House, 2.30 p.m.

Mar. 28.—Wales and Monmouthshire Junior Gas Association: Visit to Pontypool gasworks.

Mar. 28.—Midland Junior Gas Association: 'Moulded Refractory Burners and Tunnels for Industrial Purposes,' W. L. Smirles, B.SC., A.I.C. (Birmingham). Birmingham.

Mar. 29.—Western Junior Gas Association: Visit to new works of Bristol Instrument Co., Ltd., Weymouth.

Mar. 30.—Women's Gas Council: Joint Meeting of Branches, Gas Industry House, 3 p.m.

April 1.—Scottish Junior Gas Association (Eastern District): Paper, T. B. Livingstone, Perth.

April 5.—London and Southern Junior Gas Association: Visit to Shell Refineries, Shell Haven, Essex.

April 7 (Good Friday).—North British Association of Gas Managers: Spring Meeting, Ardrossan.

Ammoniacal Liquor as a Fertiliser

Successful Results of Experiments in Lincolnshire

DIFFICULTIES have been experienced regarding the disposal of ammoniacal liquor at one of the small gas undertakings in Lincolnshire. The sewage works is unable to deal adequately with the normal flow of sewage, and the sewage department has been in trouble with the River Board several times due to bad effluent. For some time the undertaking has been carting its liquor and disposing of it on a rubbish tip—an expensive procedure, the cost of carting being approximately 5s. per 500 gal., and one that in any case could not continue indefinitely.

In February, 1949, an approach was made to a local farmer with whom the use of ammoniacal liquor for agriculture was discussed. He agreed to try the liquor on his land, and he has since taken the whole of the production. The arrangement is that the undertaking provides and maintains a tank of 500 gal. capacity, equipped with sprays at the back, and provides loading facilities, and the farmer collects at the works at his own expense.

The make of liquor is in the region of 140,000 to 150,000 gal. per annum, and being of about 10 oz. strength, one 500 gal. tank of liquor is equivalent to approximately 5 cwt. of sulphate of ammonia.

The farm taking the liquor comprises 120 acres of grassland and 120 acres of arable land, and carries 25 cows in milk together with the usual young stock. The farmer, since using the liquor, has dispensed with the use of all nitrogen fertilisers (he previously used sulphate of ammonia and nitrate of lime), and is applying, in addition to the liquor, 4 to 6 cwt. of super phosphate and 1 cwt. of potash per acre, together with ordinary farmyard manure. In his opinion this gives a balanced fertilisation. The saving effected in dispensing with sulphate of ammonia has enabled him to increase the quantity of phosphate. The total make of liquor gives the farmer the equivalent of 6 cwt. of sulphate of ammonia to the acre per annum.

Liquor was used on all last year's crops, which included oats, wheat, barley, sugar beet, potatoes, and other root crops. On one 10-acre field of potatoes, five acres were treated with farmyard manure and the other five acres with liquor. The five acres treated with liquor gave a better yield of potatoes, and this portion of the field is showing better signs with the present young wheat crop than the other portion.

A field of barley which has been treated with liquor was cut at 1 ft. high for silage, the field was dressed again with liquor, and a crop of six quarters to the acre was obtained, which was good for the dry year. An exceptional yield of sugar beet was obtained, as regards both root and leaf, the yield being 16 tons per acre.

Up to 1,500 gal. of liquor per acre has been used on grass and silage crops. Grazing fields were alternately treated with liquor and then grazed. During the dry period of last year, when most grass fields were poor and milk yields falling, both the quality of the grass and the milk yields were maintained. The yields of hay were also good for the year. It was noticed recently that some young beasts out in a field and being fed with hay and roots were grazing on a portion of the field that had been treated with liquor only 24 hours previously.

Autumn sown corn which was treated with liquor before seeding was being grazed in the middle of February, which is exceptional.

Arable land was treated with liquor before and after seeding, and young crops during growth up to 1 ft. in height were also treated with liquor. Regular application of liquor all the year round, using wide spreaders, has been found most satisfactory. It was found that with the use of liquor there was no depressing effect on germination.

From the results experienced in this locality over the last 12 months, it would appear that where a gasworks is situated in, or adjacent to, an agricultural area, the use of ammoniacal liquor as a fertiliser is a practical proposition and of benefit both to agriculture and to the undertaking.

Short Gas Course for Teachers

A short course for teachers of Gas Engineering (Manufacture and Supply) and of Gas Fitting will be held in London from July 9 to 14, under the general direction of H.M. Inspector, Dr. P. C. L. Thorne, assisted by other H.M. Inspectors.

The main purpose of the course will be the consideration of methods of teaching the above subjects in technical colleges and evening institutes. Emphasis will be laid on the conduct of theory and practical classes, and the use of the voice, and teaching aids. The syllabuses of the examinations of the Institution of Gas Engineers and of the City and Guilds of London Institute and their recent papers will be discussed.

It is hoped to hold the course at various places in the London area to suit the subject under discussion, but for the most part lectures and discussions will be held at Westminster Technical College and the Institution of Gas Engineers. A detailed programme will be issued later and sent to applicants selected to attend the course.

A limited number of teachers can be accommodated at College Hall, Malet Street, W.C.1, at a cost of £5 5s. for the period from supper on the evening of Sunday, July 9, to breakfast on Saturday, July 15. This payment includes bed, breakfast and supper. Applicants should indicate on their application form if they desire to have accommodation reserved for them. No tuition fee is charged for the course.

The Ministry will, subject to regular attendance and compliance with the rules of the course, be prepared to repay the expenditure on travelling necessarily incurred, if, and so far as, this expenditure exceeds 10s. Repayment will be limited to the cost over 10s. of the 3rd class monthly return railway fare by the cheapest route from the address from which the member travels to attend the course. This limit will apply whether the journey is made by rail or otherwise. Cab or omnibus fares will not be allowed in addition to railway fare. For members travelling daily from their homes, the Ministry's grant under this paragraph towards a member's travelling expenses throughout the course will not exceed £1.

The Institution of Gas Engineers is prepared to subsidise the attendance of teachers approved by the Ministry of Education at this course by refunding the balance of 10s. travelling expenses not paid by the Ministry and a subsistence allowance up to £6 for the period of the course. The maximum grant from the Institution will not exceed £6 10s. per teacher.

Application for admission must be made to the Ministry of Education (Teachers' Short Courses), 20, Belgrave Square, London, S.W.1, on Form 106 Trs. (S.Cs.) obtainable from local education authorities or from the Ministry, and should reach the Ministry in accordance with the directions on the Form not later than June 3.

Midland Juniors' Visit

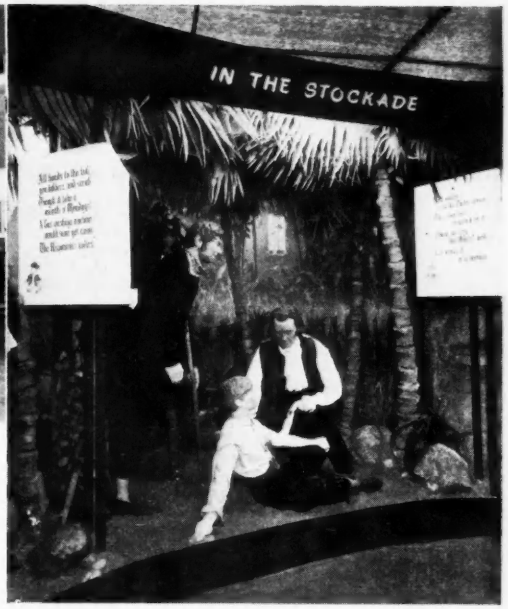
On March 2 the Midland Junior Gas Association visited the Birmingham works of Belliss and Morcom, Ltd., where they were welcomed by Messrs. Legat, Harrison, and Stephenson on behalf of the Company. Some 50 members attended and divided into parties of ten, each party being separately conducted round the extensive works.

Some members chose to visit the Ledsam Street works to see smaller types of engines and temperature control shops, together with the administration, training and design departments; others spent the afternoon at the E.M.D. works, Icknield Square, and visited the testing and research laboratory.

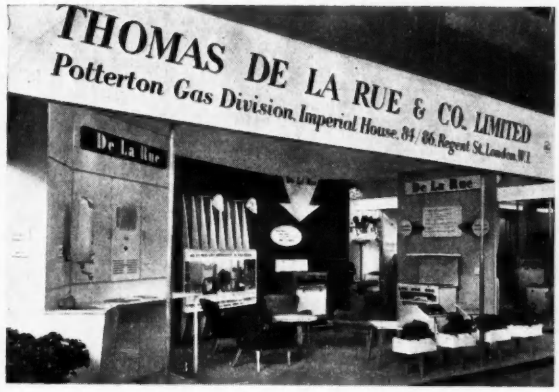
In the turbine erecting shop, the fitting of turbine plates to turbine wheels evinced particular interest, and the method of getting exact and meticulous balance in the latter was fully demonstrated. Finally, castings, crankshafts, and other large components were seen in course of manufacture.

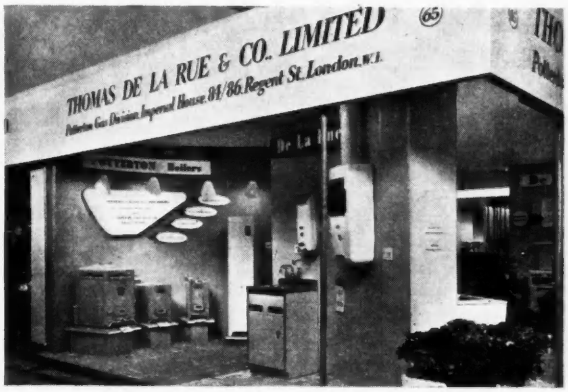
Later the members were entertained at tea in the canteen, when a vote of thanks to the Directors of the Company was proposed by Mr. S. C. Bentley, the President.

Pictures from the Ideal Home



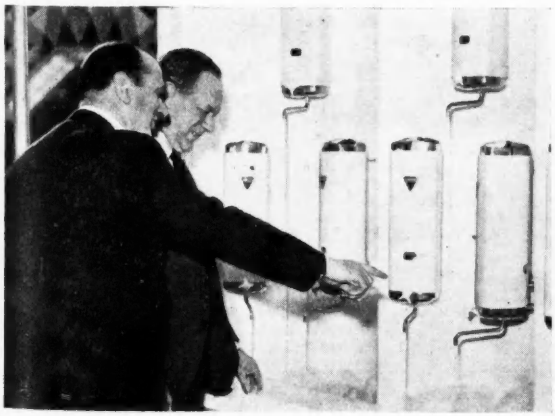
These photographs give an impression of the Gas Council stand at the Ideal Home Exhibition. The entrance to the 'Treasure Island' sequence, described last week, is at the extreme left of the general view; at the right is a close-up of one of the tableaux. The two photographs below show two aspects of the stand of Thomas De La Rue & Co., Ltd. (Potterton Gas Division), one of the most attractive in the show. Creating particular interest at this exhibit is the new large capacity cooker shown here in two variations, the B.6 and the G.5.





Below: Sir Edgar Sylvester, Chairman of the Gas Council, admires the array of Type 503 instantaneous sink heaters on the stand of Ascot Gas Water Heaters, Ltd,. Type 503, a new model, was recently described in the Journal.

Below: Miss Boswell, Home Service Organiser for the North Thames Gas Board (North Western Division), at the microphone on the Ministry of Food stand, where the Gas Council is giving regular demonstrations.



GAS UNDERTAKINGS' RESULTS

Alliance and Dublin Gas Consumers' Company.

The report and statement of accounts for the half-year ended December 31 show a surplus on revenue account of £63,113, compared with £61,344 in the last half-year. After providing for interest and income tax, there is a net profit of £36,044, to which has been added £2,667 for interest on investments and £14,257 brought forward, making a total of £52,969, against £49,385 for the last half-year. Payment of an ordinary dividend of 3% (same) leaves £17,178 to be carried forward.

Cork Gas Consumers' Company

After providing £4,000 for depreciation and paying an interim dividend of 3%, which absorbed £3,009, the balance of profits of the Cork Gas Consumers' Company for 1949 amounts to £7,812, compared with £3,093 in the previous year. A final dividend of 3%, making 6% for the year, absorbs £3,009, leaving a credit of £4,803 to be carried forward, compared with £139 brought in from the previous year. The Engineer's report says that two retort settings are due for complete resetting this summer.

Ramsey Gas Light Company

Presiding at the annual meeting of the Ramsey Gas Light Company, Isle of Man, Mr. W. E. Lace said gas sales at almost 45½ mill. cu.ft. held their own by comparison with previous year's sales. The Company's coke production was insufficient to meet the demands of customers. It was largely due to the revenue from fittings sales that they were able to supply gas at a rate which was below the maximum price permitted by the Gas Regulation Act. On the maintenance and extension of the plant and property, he said they had continued steadily during the year with the work of installing gas services to a gratifyingly large number of new premises and in repairing existing services. In addition to the installation of a new drum and shaft to the works station meter, a number of other improvements had been made. A resolution recommending the payment of a dividend of 40s. per share was carried. Reference was made to the limited percentage permitted under the Act to be set aside for renewals, and it was suggested that in these days of high costs there should be some amendment of the regulations to permit larger expenditure on renewals and so forth.

Douglas Gas Light Company

The need for an amendment of the Gas Regulation Act, 1929, to meet present-day requirements was emphasised at the 115th meeting of the Douglas (Isle of Man) Gas Light Company.

In his speech to the shareholders, Mr. R. W. Hampton (Chairman) said that the reserve in the Special Purposes Fund would be depleted, if not exhausted, in the coming year in payment for a new gasholder which was under contract for erection.

The fund, he pointed out, standing at £35,700, which had taken a number of years to build up, was at the maximum allowed by the Gas Regulation Act, 1929. Both the Renewal and Special Purposes Funds were inadequate because the Act was passed in different conditions from those which obtained today. The funds were seriously handicapped at their present limits in relation to prevailing prices.

The Special Purposes Fund, he added, would have been adequate in ordinary circumstances for its stated aim, but money now commanded a third or less purchasing power and replenishing of the Fund at the rate allowed would be a slow process.

A shareholder, Mr. A. Kitto, suggested that if the Fund was going to be used up on one new piece of plant it was time an alteration was made in the amount it was possible to put aside each year. It was an extraordinary thing to have to be tied to values which existed so many years ago, he added.

Mr. Hampton said the matter had been concerning the Directors for some time, and it was hoped eventually to have an alteration made in the existing legislation. He added that the Company, because of continued increased costs of production, had been reluctantly compelled to increase the price of gas and the resultant increase in revenue had been barely sufficient to take care of the additional costs incurred.

Profit for the year was £8,826, to which was added £1,001 interest on investments, and the carry-forward from the previous year of £4,567, making £14,394 disposable. An interim dividend of 7d. per share was paid last December, and a further dividend of 9.8d. per share, being the standard dividend allowed under the Act, was now proposed, leaving £4,398 to carry forward to next year's accounts.

On being re-elected a Director, the Chairman said he had attended one-third of the 115 meetings of the Company, and that meeting was the 21st anniversary of his election as a Director.

North British Meeting

The spring meeting of the North British Association of Gas Managers, to be held on Good Friday, April 7, in the Assembly Hall, Bute Place, Ardrossan, will commence at 10.15 a.m., when Provost J. Beggs will welcome the Association to Ardrossan. The President's address will be followed by a luncheon at 12.45 p.m. in the Town Hall, Glasgow Street, Ardrossan. In the afternoon members will visit the Ardeer Explosives Factory of Imperial Chemical Industries, Ltd., after which they will be entertained at tea at Africa House. The meeting will be preceded on April 6 by a golf competition for members of the Association's Golf Circle, which will be held at West Kilbride Golf Club at 9 a.m.

Home Service Advisers

The Gas Council proposes to hold a business conference in London for Home Service Advisers starting at 2 p.m. on June 15, and concluding at 5.30 on June 16.

The programme will include lectures and practical demonstrations on various aspects of home service work, and ample time will be allowed for discussion of individual home service problems.

Gas Valuations

Forty-eight securities of 33 gas undertakings are included in a new list of gas compensation values, shown below, which was published by the Ministry of Fuel and Power on March 10. Inclusive of these stocks, 1,672 out of a total of 1,951 have now been assessed, and approximately £173.2 mill. of British Gas stock has been issued in compensation. This total includes £5.8 mill. in respect of 44 valued out of a total of 62 stocks in composite companies. Securities in the following list are in units of £100 unless otherwise indicated.

Company	Compensation Value
Ayton Ord. (10s. unit)...	15/–
Banchory Ord. (£1 unit, 19s. paid) ...	24/–
Bentham 6% Red. Deb.	£100/5/–
Do. Ord. (£5 unit)	£7
Bo'ness Ord. (£5 unit)	£15
Brynmawr and Blaina 4% Deb. ...	£102
Do. 5% Cum. Pref.	£112
Do. Ord.	£165
Burgess Hill and St. John's Common 3¼% Red. Deb., before January 1, 1946...	£101/15/–
Catrine Ord. (£115s. unit)	95/–
Chipping Sodbury Ord. (£5 unit) ...	£6/5/–
Cinderford Ord. (£1 unit)	66/–
Coldstream Ord. (£1 unit)	21/–
Hayfield Orig. Ord. (£5 unit)... ...	£6/10/–
Do. Addl. (£5 unit)	£5/5/–
Hayle Ord. (£5 unit)	£6/15/–
Holderness 4½% Red. Mort Deb. ...	£100
Do. Pref. (£1 unit)	20/–
Do. Ord. (£1 unit)	5/–
Kidsgrove 7% Stand. Ord. (£10 unit)	£16/10/–
Kirkburton Shelley and Shepley Ord. (£1 unit)	24/–
Kirkby Stephen Ord. (£5 unit) ...	£6/15/–
Lerwick Ord. (£1 unit)	15/–
Lesmahagow Ord. (£1 unit)	10/–
Long Sutton and Sutton Bridge 6% 1st Mort Deb. (Series 'A') ...	£105
Do. 6% 2nd Mort. Deb.* ...	£65
Do. 5% 3rd Mort Deb.	£100†
Do. 4% 1st Mort. Deb. (Series 'B')	£100/10/–
Maybole Ord. (£5 unit)	£12/10/–
Melton Mowbray Ord. (£20 unit) ...	£47
Newbiggin-by-the-Sea 4% Red. Deb.	£100
Oban Ord. (£1 unit)	35/–
Selkirk Ord. (£1 unit)...	45/–
Shifnal 5% Red. Deb....	£100
Do. Ord. (£1 unit)	189/–
Stirling 4% Consol. Pref.	£102
Do. Consol. Ord. (£1 unit) ...	36/–
Thornbury Ord. (£1 unit)	21/–
Do. Ord.	£105
Uttoxeter 10% Stand. Ord. (£5 unit)	£11
Wem Ord. (£5 unit)	£10/2/6
Westhoughton New 'B' (£10 unit, £2 paid)	4/–
Samuel While & Son, Ltd., Ord. (£1 unit)	22/–
Wooler Ord. (£1 unit)...	42/–
Yorktown (Camberley) 6% Red. Mort. Deb.	£107
Do. 5½% Red. Mort. Deb. ...	£105
Do. 5% Red. Deb.	£108
Do. 3½% Red. Deb., before January 1, 1946	£103

* The principal sum (£100) was repayable by half-yearly instalments. At vesting date £60 17s. 9d. was outstanding per £100 debenture.

† The value of these securities has been determined by reference to the price of issue in accordance with Section 25 (6) of the Act.

Central Heating Installations

Recent Developments in the Newcastle Division

TYPICAL of the many large gas-fired hot water central heating installations which have been fitted and are now operating in the Newcastle Division during the past 18 months is that of Scott and Turner, Ltd., Fawdon, near Newcastle-on-Tyne An extension to their existing works was completed in 1948 and is now engaged in the manufacture of tin packages and fillings for the well-known commodity Andrews Liver Salts, and other medicinal products of the company. The new buildings are laid out on modern lines and consist of two 'L' shaped single storey blocks 185 ft. x 75 ft. x 15 ft. and 150 ft. x 75 ft. x 15 ft. high respectively, constructed of brick and ferro concrete, each covered by a 75 ft. single span, domed concrete roof.

Heating arrangements for the new extensions are provided by 26 overhead 'Copperad' air heaters supplied with hot water at a temperature at the heater of 165°F. from the central heating boiler. The heater units each have a maximum output of 50,500 B.Th.U. per hr.

The central heating plant is located in a spacious boiler room and consists of one vertical 11D Cochran Kirke Sinuflo hot water boiler, 5 ft. 6 in. diameter by 6 ft. 6 in. high, having a maximum rating of 2.070,000 B.Th.U. per hr. with a gas consumption of 5,750 cu.ft. per hr. Ample space is provided for an additional unit which may be required to cover any future extensions.

Gas to the burner equipment is taken from a 6,000 cu.ft. meter through an 8 in. branch reducing to 4 in. in the boiler room and fitted with a main shut-off cock, Thorp combined cut-off governor, and relay valve.

Automatic temperature control is provided by means of a Drayton type VT/o thermostatic pilot valve operated on the vapour tension principle and connected to a bulb immersed in the boiler water. The valve is normally set to control the flow temperature at 185°F. A 4 in. accelerator is arranged in the flow main adjacent to the boiler for pumping the hot water through the system.

The whole of the heating installation was carried out by G. N. Haden & Son, Ltd., a local firm of heating engineers.

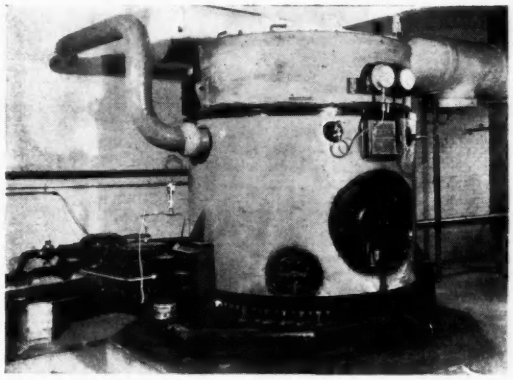
Another example of a modern central heating plant is now in operation at Tyneside Safety Glass, Ltd., Team Valley Trading Estate, Gateshead. This firm is engaged in the manufacture of safety glass for the motor-car industry and gas is used on a large scale for the processing of this particular product.

Heating for the manufacturing sections of the works is provided by a number of Dunham overhead unit air heaters supplied with hot water pumped from the central heating plant, each unit having an output of 52,500 B.Th.U. per hr. Administrative buildings and offices are heated throughout by 'Dunham' cabinet convectors.

The central heating plant consists of two 3 GBA.13 'Ideal' gas-fired hot water boilers, each having a maximum rating of 1,430,000 B.Th.U. per hr. with a gas consumption of 3,575 cu.ft. per hr. Space is provided in the boiler room for two additional units to cope with possible future extensions to the factory.

Gas for the heating boilers is taken from a 50 B. & M. meter through a 6 in. service pipe to a position along the rear wall of the boiler room where two 3 in. branches are taken off to supply the two sets of control equipment and burner manifolds on each unit.

Steam for process and hot water for domestic purposes is provided by a 17c Cochran Kirke Sinuflo boiler supplying 5,075 lb. of steam per hr. at 80 lb. per sq. in. gauge with a gas consumption of 15,100 cu.ft. per hr.

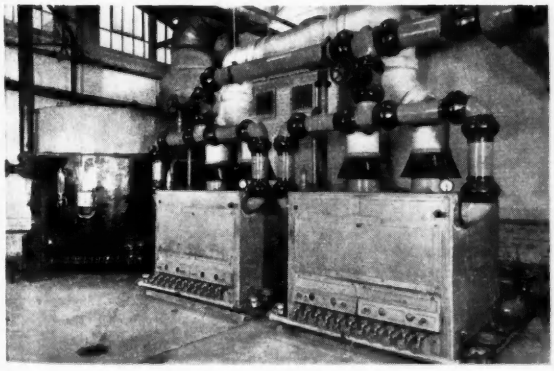


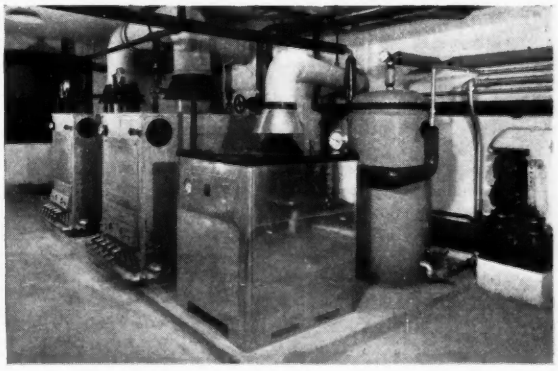
The central heating plant at the Fawdon works of Scott and Turner, Ltd. The Cochran Kirke Sinuflo boiler has a rated gas consumption of 5,750 cu.ft. per hour.

The gas requirements for this steam raising unit is taken from a 60 B. & M. meter in the boiler room. Messrs. L. Vaux, consultants, were responsible for the whole layout, the installation being carried out by the Brightside Foundry and Engineering Co., Ltd.

A representative example of a modern school central heating plant which is worthy of mention is installed at the Convent De la Sagesse Secondary and Kindergarten School for Girls, Jesmond, Newcastle. The installation consists of two 3 GBA.7 'Ideal' hot water central heating boilers each having a maximum rating of 650,000 B.Th.U. per hr. with a gas consumption of 1,625 cu.ft. per hr. The school is heated throughout by 'Ideal' Neo-Classic radiators supplied with hot water at a temperature of 175°F from the boilers. An accelerator is arranged in the flow main to pump the hot water through the system.

The standard type of burner controls is provided and consists of governor, limit thermostat with on-off gas control valve, clock control, bi-metal flame failure device, and permanent pilot. Domestic hot water is supplied from a 2 GBA.5 'Ideal' boiler having a rating of 220,000 B.Th.U. per hr. and a gas consumption of 550 cu.ft. per hr.





Left.—Tyneside Safety Glass, Ltd., manufacturers of safety glass for the motor car industry, use gas on a large scale for the processing of their product. The three boilers illustrated have an aggregate gas consumption of 22,250 cu.ft. per hour. Right.—A modern school central heating plant has been installed at the Convent De la Sagesse Secondary and Kindergarten School for Girls at Jesmond, Newcastle, two 'Ideal' boilers being used for central heating and one 'Ideal' boiler for domestic hot water for ablutions, &c.

Home Service Show at Gas Industry House

THE accompanying photograph is a reproduction of the display board headed 'Home Service,' which is in the entrance hall of Gas Industry House, and gives in pictures a brief outline of Home Service work. The sub-heading, 'Consultant and Advisory Services on All Aspects of Sales and Services to Women,' refers to the services available to undertakings from the Home Service Department of the Gas Council.

The pictures on the left of the display panel show students at a domestic science college training for diplomas in cookery and household management. When trained they have a variety of careers open to them—for examples, as teachers under the Ministry of Education or as Home Service Advisers in the gas industry.

The Gas Council has an employment panel and on request from undertakings endeavours to introduce qualified candidates to fill vacancies as they occur. There is still a dearth of suitably trained women because the domestic science colleges have not yet caught up on arrears of training due to the war years and also the current demand for women trained in domestic science exceeds supply.

On appointment to the gas industry the candidate has to receive training in gas technology, home service organisation, and demonstration presentation. The small inset photo shows a well groomed home service adviser wearing crisp white overall and cap and green and gold home service badge.

To keep up to date with developments affecting their work both in and outside the gas industry, home service advisers attend area home service discussion groups and the Gas Council's annual national home service conferences.

HOME SERVICE
CONSULTANT AND ADVISORY SERVICES
ON ALL ASPECTS OF SALES AND SERVICES TO WOMEN
HOME SERVICE IS GROWING
Newsletter

A Comprehensive Picture

The pictures on the right of the display panel show: (1) A gas cookery demonstration in progress—its object being to sell new gas cookers by showing how easy it is to turn out well-cooked dishes with modern equipment. (2) Home service advisers call on consumers in their own homes to make sure that the customer knows how to get the best out of all her gas appliances and how to take good care of them—an important point when so many undertakings are now selling appliances on hire purchase terms. (3) Cookery classes for special groups of customers are well worth while, for examples, engaged girls, business girls, girl guides, and so on. (4) Demonstrations at exhibitions are useful for attracting people who do not visit gas showrooms and demonstration theatres.

The centre panel gives figures on the past and present strength of home service and an indication that the ideal of one demonstrator per 10,000 consumers may be attained in the not too distant future.

Some of the items on the display board are available from the Gas Council. They include an eight-page folder showing the value of home service departments to gas undertakings and to the consumer; a companion folder dealing with demonstrations under nine divisions; the home service badge depicting a gold Mr. Therm on a white and green enamelled background, with red lettering; and a leaflet suitable for careers mistresses and others seeking information on the professional training, qualifications, and work of a home service adviser in the gas industry.

Other items on the board are copies of home service and women's magazines in which editorials have been included on careers in the gas industry and similar subjects.

Mr. Crowther Addresses Northern Juniors

A meeting of the Northern Junior Gas Association was held at Newcastle on March 10, the programme comprising an address by Mr. E. Crowther, Chairman of the Northern Gas Board, preceded by a film display which showed the important work done by the East Coast colliers in transporting coal from Durham to the London gas undertakings.

The meeting was followed by a tea provided through the courtesy of Mr. J. E. White, Divisional General Manager of the Newcastle Division.

A vote of thanks to Mr. White, of the Newcastle Division, was proposed by Mr. W. O. Kirkwood, of Sunderland, and a vote of thanks to Mr. Crowther for his address was proposed by Mr. G. Perks, of Stockton. In his remarks, Mr. Perks expressed the appreciation of the Association on receiving an address from Mr. Crowther and emphasised the fact that the problems which faced unit managers were small when compared to the complexities of organisation and the difficulties which had to be surmounted by the area boards.

Mr. Crowther's address was given to an audience of nearly 100 members of the Association, which was a record attendance and indicated the keen interest and appreciation which was shown in the address. An address of this nature by the Chairman of the Area Board to a Junior Association undoubtedly goes a long way to foster good relations between the Juniors and the area boards. The large attendance at the meeting also indicates the rapid development of this new branch of the Junior Association tree. Since the reorganisation of the former Auxiliary Section of the North of England Gas Managers' Association into an independent Junior Association it has been re-vitalised, and evidence of this is the continually expanding membership which now numbers 150, greater interest displayed, and much improved attendances at meetings. When regard is paid to the widely scattered area covered by the Northern Juniors, the keenness shown in attending meetings is wholly admirable.

Mr. Crowther's address will be found on the opposite page.

THAT INSIDIOUS NEW DISEASE — FRUSTRATION*

By E. CROWTHER, M.Eng., M.I.C.E.,
Chairman, Northern Gas Board

EDITOR'S NOTE :— **Past President of the Institution of Gas Engineers and before vesting day General Manager and Chief Engineer of the Newcastle and Gateshead Gas Company, the author attributes the present wave of frustration to a misunderstanding of the aims of those in senior positions and of the reasons for their actions. Reorganisation is under way, but as the 'new machines are run in' he is confident that steps will be taken to remove any causes for misunderstanding which may then remain.**

THE Junior Associations should have as their aim the development to the full of the technical abilities of their members, and should serve as post graduate colleges and as centres for the discussion and improvement of every detail of the chemical, physical, and engineering technique upon which the practice of gas manufacture and supply is based.

With these considerations in mind, I was at first disposed to suggest to you some of the directions in which investigation may be expected to lead to technical progress, for I am convinced that there has never been a period in the history of the industry more favourable than the present for the emergence of new ideas and new approaches to familiar problems of many kinds.

The past 12 years have seen a profound change in our circumstances. Instead of cheap and abundant coal, we have limited supplies, not always of the qualities we would select, at prices increased threefold. Reserves of plant have been absorbed by spectacular increases in the demand for our main product, and new construction is both slow and very costly. The drive for production in every field of activity has made it difficult to engage suitable operatives in sufficient numbers and governing the whole situation is the disappearance of the reserves in the shape of foreign investments which before the war enabled the country to maintain its international solvency.

In such circumstances, it is clearly imperative that we should use every effort to conserve raw materials and to make the most efficient and economical use of our share of the national resources of manpower, giving the closest consideration to the operation of existing plant and processes and the selection and location of such new plant as we must have.

Here is the urge to progress, and the new instrument placed in our hands—the ability to integrate and combine our operations on a greater scale than hitherto—gives us an opportunity to meet the demands of these critical times. Used wisely and with discrimination, this instrument will enable our industry to add significantly to its already great contribution to the national economy and the decade before us offers the promise of being among the most fruitful in its history.

The urge and the opportunity call for men of intelligence, vision and enthusiasm, and they will be sought among such Associations as this.

While I should have liked to discuss with you, as an engineer, some of the matters which would appear to me to be likely to repay investigation, I must leave the subject and pass on to another, as I feel that since so many of you are employed in the service of the Northern Gas Board, you will expect me to say something about the policy of the board, particularly in so far as that policy may be important to yourselves.

During the months which have elapsed since vesting day, the board has begun to get a clear idea of the strong and weak points of the undertakings of the area, from which to determine what requires to be done and in what order.

Our first duty was, of course, to make sure that nothing vital to the continuity of operation and management should be overlooked at the actual date of change over ; banking arrangements had to be made, persons authorised to draw upon the banks for the payment of wages and the settlement of accounts, and committees constituted and put to work to take over duties previously performed by municipal committees and boards of directors.

The question of grouping the undertakings in the most suitable and workable manner called for careful thought with the consideration of many factors, of which the human factor was not least important.

Since it is always easier to merge two or more undertakings into one than to reverse the process, the plan adopted was to create at the outset 10 divisions, each controlled by a general manager responsible to the board through a committee of management. Except for certain matters which can only be dealt with satisfactorily on an area basis, such as the purchase of coal, the sale of coke for export and in large bulk, the negotiation of coke oven gas contracts and the like, the day to day authority of the Board has been delegated to the divisional general managers and their committees.

Co-ordination between divisions is secured in two ways : through regular meetings of the managers and through the presence on each divisional committee of management of several members of the board itself, who are thus able to ensure that decisions taken by the committees are in harmony with the policy of the board.

The divisional managers in turn are free to delegate responsibility to the unit managers, making suitable arrangements to co-ordinate the work of the latter, and to acquaint them with the overall aims of their division.

The detailed management of each division must of course vary considerably according to circumstances ; on the one hand is the compact and densely populated Newcastle division, already fully integrated both physically and administratively, while on the other hand in a rural division such as Penrith no physical integration exists or is likely to do so for some time and administrative linking is only in its early stages.

Experience will, no doubt, suggest modifications, just as the administrative integration of the units within each division and the elimination of some of the smaller manufacturing stations may make it practicable to reduce the number of divisions should this appear desirable. Be this as it may, the board can be satisfied that the machinery which it has created is proving able to do the work expected of it, its greatest disability being the number of divisional meetings which it requires of members of the board, with consequent reduction of the time otherwise available to them for direct contact with the units.

This is a matter which it will be necessary to correct as the board feel it to be no less important that they should be well acquainted with the units and those engaged in them as that each post throughout the area should carry with it the full measure of responsibility which its description implies.

I should have liked at this point to spend some time in outlining the more important engineering works which the board has in hand or in prospect and of which you may already have seen something in the press. The Gas Act requires the board to keep the consultative council informed of its plans in matters affecting gas supply and a detailed statement has been placed in their hands and with their approval communicated to the press. It contains an impressive list of projects, notwithstanding the fact that every one has had to pass at least one of two tests before being accepted by the board—either gas supplies could not be maintained without it, or alternatively the immediate economies to be derived from it would more than repay its cost.

The overall picture is, as you would expect, influenced in large measure by existing and prospective supplies of coke oven gas, as the board and the National Coal Board are required by

* Address to the Northern Junior Gas Association, Newcastle-upon-Tyne, March 10, 1950.

the Gas Act to co-ordinate their carbonising activities in the interests of national fuel economy.

There already exist several sections of what will eventually become a gas grid, covering an industrial belt extending from north of Blyth down to the southern boundary of the board's territory and some 20-30 miles in width.

Development of further portions of this grid is already going forward. Into it will be fed all available coke oven gas, together with the production of modern gasworks plants at Stockton, Darlington, Sunderland, and Tyneside, with possibly others in addition. Construction of new continuous vertical installations is planned or proceeding at Stockton and Sunderland, with extensions of existing similar plant at Darlington and Blyth, while a large installation of chamber ovens at Howdon, to carbonise 550 tons of coal per day is expected to be completed during 1952. As the grid develops and more gas becomes available to it, a number of secondary gasworks will cease to be producing stations ; among the earlier ones will be Morpeth, Annfield Plain, and Crook, with others to be considered later.

On the westerly side of the board's territory, a local gas grid, based on Workington and supplied with coke oven gas, already caters for a considerable area. Arrangements have been made to increase the quantity of coke oven gas purchased and to extend the grid to cover West Cumberland, with the cessation of manufacture at Whitehaven, Maryport, Aspatria, and Cockermouth, as well as (eventually) Seascale and Silloth.

Carlisle will continue to be a major manufacturing station and will extend its mains to Brampton and probably to Wigton.

The non-industrial areas which lie between the two coastal belts and extend north to Berwick-on-Tweed offer no prospect of economical linking up and here the board's chief concern must be to overhaul inadequate distribution plant, and to modernise manufacturing plant as far as is economical. Investigation is proceeding into the possibility of road transport of gas under pressure to some of the smallest units such as Rothbury and Bedale and the merits of oil gas plants are also being examined. Should ample supplies of butane and propane become available, these may offer a further alternative to present practice at the smallest works.

You will recognise that planning of the work thus briefly touched upon has absorbed a great deal of the board's time and has necessitated some postponement of other necessary activities. In determining the relative urgency of its duties, it has been impossible for the board to ignore actual and prospective shortages of gas in parts of its area and the fact that major construction occupies several years before it can be completed. At the same time, the board has by no means overlooked its other responsibilities and as engineering plans take final shape, the board will be able to turn more attention in other directions.

I stated a few moments ago that it is the board's intention that each post should carry with it the full responsibility appropriate to it. Let me here digress to say a word about responsibility and its proper exercise.

Its essence is an ability to understand when circumstances within one's province call for action, to decide correctly what action, perhaps from among a number of possible courses, is the best and to take that action. It also requires the ability to convey to the minds of others a recognition that action is required and that the intended action is well selected.

This is what underlies the giving of instructions; in fact the circumstances themselves give the instructions to the person within whose province they occur, whether he be senior or junior.

A conception of responsibility and of instructions and its understanding by every individual engaged in a joint enterprise, is essential to success. It leads one to certain conclusions:—

Responsibility cannot be concentrated in a few senior people. Their chief responsibility is to find others well fitted by experience and common sense to occupy each post in the enterprise, leaving themselves free to concentrate upon the more complex sets of circumstances, in the knowledge that the action required by circumstances of less complexity will be correctly taken without their intervention.

Just as the more senior man does not hesitate to draw upon the experience of his juniors where he thinks it will assist him, so the junior, if in any doubt as to the proper action in any circumstances, must pass his responsibility up the line to his senior, never counting on good luck to lead him to a sound decision.

Above all, complete and accurate information must be available in every set of circumstances: a missing factor may be vital and without it any decision taken may prove to be entirely wrong.

For this last reason, it will be understood that the board must equip itself with a great deal of information if it is to conduct its affairs properly. Returns and tabulations are no doubt troublesome to those asked to prepare them, occupying time which can ill be spared from other and often apparently more important duties, but it must be accepted that the board is well aware of the work involved and asks for nothing without good reason.

Financial estimates and returns especially are essential to effective control of an organisation built up of a number of units: without these the formulation of sound plans and policy would be impossible. In fact, the board would be in danger of falling a victim to that insidious new disease which, if we are to credit all we read, has infected certain sections of nationalised industry. Its name, too often heard, is 'frustration.'

I do not believe that its infection has spread to any of us concerned with the Northern Gas Board and I think our common sense will keep us immune, dangerous though catch-words of this nature can be.

If I were asked to define frustration, it would be tempting to suggest that it is the feeling experienced by an individual on first realising that though engaged in a nationalised industry, he is still expected to do some work, but this would be less than fair and I suppose that where the feeling does exist, it is due to a misunderstanding of the aims of those in senior positions and of the reasons for their actions.

When considerable reorganisation is under way, it is not difficult for misunderstanding to arise, but as the preliminary work is completed and the new machines have begun to run themselves in, I am confident that the most active steps will be taken to remove any causes for misunderstanding which may then remain.

There is no doubt that if the nationalised industries are to achieve all the success of which they are capable the best personal relations must exist throughout all ranks. In our own board, the further development of those duties falling under the headings of education and of health safety and welfare, to which much thought is now being given, will contribute largely towards maintaining the traditions of which the industry is justly proud.

There is a great field waiting to be developed here and much consultation will be necessary before we can solve many questions—questions for example such as the periodic transfer of junior staff from division to division and even from board to board for the widening of their experience—housing is not the least of the present difficulties in this regard and the provision of means whereby young men of ability and character may most readily progress from manual to technical and from technical to management duties as they show themselves capable of it.

In the meantime, I am very pleased to learn that the District Education Centre, with the co-operation of divisional general managers, has already established a discussion group for diploma candidates ; equally I am pleased that at many of the works and depots useful experience has already been gained in the organisation of works committees.

As time goes on and physical and administrative integration is carried to its most favourable point, there will be increased scope in the industry for specialists, both technical and commercial. Specialisation should, however, be superimposed upon a background of comprehensive knowledge, so that specialists in different branches may find no difficulty in combining their work and knowledge to a common end.

This Association can do much to assist in providing a common background and I commend this work to you.

NEW REFRACTORIES AND INSULATING MATERIALS*

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IT is the object of this paper to give account of experiences in the last few years in the use of new refractory materials. They represent efforts to provide satisfactory solutions to fresh problems of temperature and working conditions in a wide variety of applications, but when they are collected together they constitute an addition to the more traditional materials.

It is probably true to say that the new materials and techniques to be discussed were all brought into service by the present trend, in one form or another, towards higher working temperatures. To take one example, the jet engine and gas turbine have engendered considerable activity in the field of high temperature metallurgy and thus, also, a need for furnaces at higher temperatures for heat treatments. Powder metallurgy, again, is a new and expanding field involving temperatures upward of 1,600° C. and into which the industrial gas engineer must enter sooner or later.

The Up-grading of Mild Steel

In a paper devoted to the problems of dealing with increased temperatures it seems proper to start at the lowest point on the temperature scale. This is represented for us by the black emitter industrial radiant heating panel (Fig. 1) in which a black mild steel sheet is heated to a temperature not exceeding 650° F. by products of combustion rising from a bar burner in a space bounded by the steel plate and by suitable insulation.

In order to shield the lower part of the plate from excessive heat and thus to maintain it at a uniform temperature, a baffle plate is fitted behind it (Fig. 2) and it is the temperature reached by this baffle plate which has, in the past, been the limiting factor in respect of the permissible working temperature of the emitting plate. If the baffle plate is made of mild steel, then it cannot be allowed to work for any length of time at above 500° C. (932° F.) and this, in turn, has meant that the radiating surface temperature has had to be limited to 650° F. A remedy for this would seem to be the application of a coating of a new refractory enamel which was initially developed for use on mild steel aeroplane exhaust manifolds. This enamel, which is similar to vitreous enamel and is applied in a similar manner, can be had in a variety of different forms depending on the service required. For example, the baffle plate of the radiant heating panel (Fig. 2) has a highly refractory, rough coating designed to give maximum protection, whereas the radiating panel has a smoother, more decorative coat (not visible in the illustration) designed to give protection to the surface without impairing its high emissivity. By this means the maximum working temperature of the panel has been raised from 650° F. to 850° F., at which temperature the baffle plate is at about 620° C. (1,150° F.); the plate shown in Fig. 2 has operated for 1,700 hours under these conditions and may be compared with the untreated plate in Fig. 3, which has had an identical working life. It should be made clear that there is no reason to believe that this represents the maximum temperature which this material will stand.

Low Temperature Insulation

As has already been mentioned, the radiant heating panels are provided with insulation. Here the need is for a slab, some 2 in. thick, of a light insulating material, easy to cut, and able to withstand about 700° C. (1,300° F.), it being remembered that the panels are sometimes used portably, which means that the insulating material must retain a certain degree of mechanical strength, especially as regards the hot surface, after it has seen some service. Normal asbestos, magnesia, or diatomaceous earth slab materials weaken too much at the hot surface, which crumbles, with resultant blockage of burners and combustion space. The effect of any general weakening is most evident when the panels are used sloping forward.

The most satisfactory materials we have yet found are the usual type of soft slab material, but with a thin hard surface skin. This surface skin, although it does crack in use, retains its mechanical strength well, with the result that slabs to which it has been applied can be used with confidence to bridge larger unsupported spans than has hitherto been possible.

Insulation up to 1,000°C

In this class I would like to draw attention to the use of exfoliated vermiculite[1]. Vermiculite is a form of mica in which water is present in such a way that when the vermiculite is heated and the water driven out, the planar structure of the mica is expanded so that it increases 20 or 30 fold in one direction only, becoming a series of leaves containing air spaces between them. Once exfoliation has taken place the material is quite stable and can be used up to 1,000° C. and this stability, coupled with the presence of a large number of air spaces, makes the exfoliated material very suitable for use as a thermal insulator.

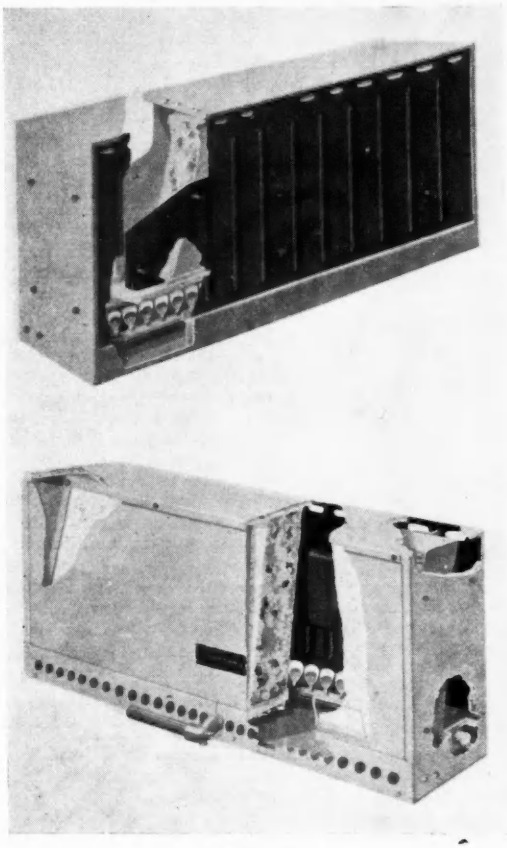


Fig. 1.

It is obtainable either as loose granular material which can be poured into annular jackets surrounding equipment, or in the form of lightweight blocks of low bulk density which can

* Short paper presented to London and Southern Junior Gas Association, March 10, 1950.

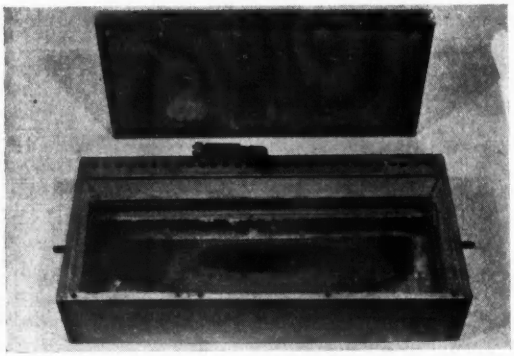
be easily cut to shape. We have found, in the course of some development work, that these blocks are not disintegrated by a steamy atmosphere.

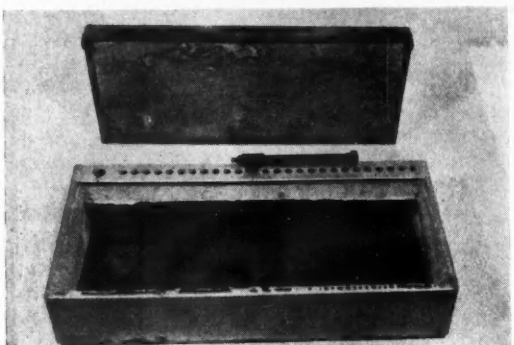
In the world of refractories there is a barrier, at about 1,200-1,250° C., to cross which involves forsaking the fireclay refractories which are the mainstay of furnace construction. Instances in which this barrier has to be crossed are becoming more frequent and one such application is the subject of a companion paper to the present one.

The upper limit of developments which can directly be foreseen at the present time is somewhere in the region of 1,950-2,000° C., where gas may hope to enter the sintering and powder metallurgy field and it is proposed to discuss some of the materials which may be found suitable for use in the temperature range 1,250° C. to 1,950° C.

Aluminous Insulating Refractories

For temperatures up to 1,550° C. it is usual to turn to the class of material known as aluminous refractory. This is of





Top: Fig. 2. Bottom: Fig. 3.

itself not new. We have, however, had to combine it with another technique which is becoming standard practice—the use of hot face insulation—and this combination is not achieved as easily as might be expected.

Fireclay insulating refractories are well established and we are accustomed to take their bulk density as a rough measure of their thermal conductivity. Vicissitudes which are described in the companion paper already referred to have, however, made it plain that at the higher temperatures at which the aluminous bricks have to work, matters are not so simple, since, with the greater preponderance of radiation at high temperatures, pore size becomes an important factor and an average pore size of about 1 mm. appears to be desirable for work in the 1,000-1,500° C. range now under consideration.

Silicon Ester Bonding

This development is based on the properties of an organic chemical compound, ethyl silicate. This substance may be kept in a solution in alcohol, but is decomposed by water to give, ultimately, silica. When this occurs, the solution, a pale straw-coloured liquid, hardens to a gel. If this is heated, volatile constituents, mainly alcohol, are driven off, followed, at higher temperatures, by water, leaving behind a deposit of silica. In practice, other materials, known as condensing agents, are added to give control of setting.

In use, the solution of ethyl silicate is mixed with a mixture of alcohol and water, the greater the proportion of water, the shorter the setting time, and to this mixture may be added a suitable refractory powder giving a cold set which is strong enough to handle. A convenient setting time is 15 to 20 min., which gives time for the mixture to be vibrated into a greased wooden mould.

An alternative method is to mix alcohol and water with the ester solution before sale, with just insufficient water to bring about gelation. This mixture is kept in sealed containers, and upon mixing with a refractory powder picks up sufficient moisture—about 3%—to induce a quick set. This, of course, relies on this refractory powder being sufficiently hygroscopic and has the disadvantage that the mixture as sold has a limited shelf life of a few months.

Initial heat treatment drives off the residual alcohol and care has to be taken to prevent this from igniting, since this would result in the deposition of carbon, which is harmful to the strength of the material. Once this stage has been passed, heat may be freely applied and at some temperature in the region of 1,200° C., the silica fluxes and forms a glassy matrix which has considerable strength.

Disadvantages at present are the limited shelf life of the silicon ester solution and the necessity for measuring out with reasonable accuracy the alcohol and water which have to be used.

The new material has been put to two principal uses. The first is the casting process already referred to, which can be applied to quite intricate shapes with good reproducibility. For example, Fig. 4 shows size 60 Hypact burners cast in two materials, sillimanite and zircon[6].

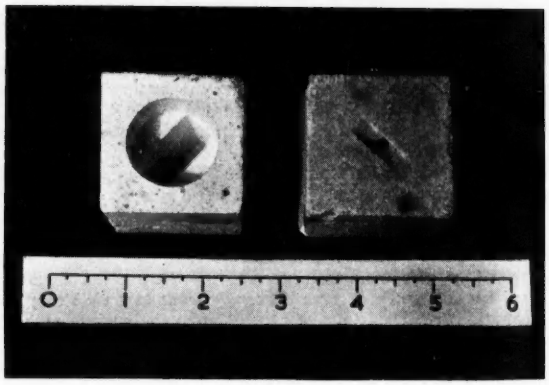


Fig. 4.

The second use is in the facing of hot-face insulating refractory bricks. The motives behind the use of insulation on hot faces are powerful but solid refractories have often to be retained in combustion chambers, &c., because the softer insulating refractories cannot withstand the erosive action of the flames and hot gases. It is possible to use the silicon ester without any refractory filler for surface hardening, although the best results obtained so far have included some filler. Naturally the usefulness of this idea is greatest when applied to the high temperature aluminous insulating refractories. If the application proves successful, it should be possible to construct furnaces entirely of suitable insulating materials and then apply a protective wash, with a brush, to the internal surfaces. Such a furnace would then have the minimum heat capacity and weight, with all the concomitant advantages.

In addition to the applications described above, which may fairly be classed as recent advances and on which we have done some experimental work with encouraging results, there

are a number of other ideas on which work is commencing, or it is hoped will commence shortly.

Among these is the problem of muffle linings able to withstand both thermal shock and high temperatures and, in this direction, samples are being collected in a variety of materials —silicon carbide, sillimanite fused alumina, mullite, and zircon. Mullite pieces of this size are a new development, but we have been using mullite pyrometer sheaths up to 1,500° C. with success. Much work has been done recently on the use of zircon in refractories [6 7], and tests on the zircon muffle are awaited with interest.

A sample of fused magnesia brick, very dense and claimed to be able to withstand 1,950° C., has been obtained, but there has not as yet been any opportunity to try it.

The logical goal in the production of standard furnaces would seem to be the use of a thin-walled lining about ¼ in. thick cast possibly in silicon ester-bonded zircon or sillimanite, placed in a box and backed with a granular insulating material poured in before the outer case is sealed. The excellent resistance to thermal shock claimed for silicon ester-bonded materials gives hope that quite complex mouldings would prove satisfactory in this respect. Such a furnace would be the cheapest possible to construct. Granular insulation might be exfoliated vermiculite or magnesia powder. It is proposed to construct an experimental furnace on these lines as soon as possible.

The principal limitations under which the designer of industrial heating equipment labours are frequently those set by available materials of construction. The work of development therefore entails a perpetual search for new materials. A number of new materials are now making their appearance, and it is to be hoped that the gas industry and the manufacturers of these materials will together make it their business to exploit the potentialities of them to the full in order to provide industry with equipment able to operate serenely under conditions of ever-increasing severity, and, of course, always with economy of fuel and capital.

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EVOLUTION OF HYDROGEN SULPHIDE BY STRAW*

By M. WILLIAMS, B.Sc.

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CONTAMINATION of clean gas due to evolution of H_2S by a box which is in the third or fourth taker position, and which has in front of it one or more clean boxes, happens infrequently, but the occasions when a box evolves H_2S for no apparent reason causes some concern. There are three mains reasons why a box evolves H_2S:—

1. Leaky valves.
2. Tapping of liquor by oxide which has fallen through the grids.
3. Chemical or biochemical reactions.

Leaky valves can be traced by investigation, and the necessary repairs can be made at some future date.

The prevention of oxide from falling through the grids is another matter entirely. I have seen such oxide emptied from a box, usually in a wet and soppy condition, weighing anything up to five tons. I have also heard reports of the gas space beneath the grids being full of oxide. It is obvious that unless one is exceedingly fortunate oxide will fall through the grids, this despite the fact that all due attention has been paid to the moisture content of the freshly charged oxide.

To prevent the oxide falling through the grids, some works resort to the practice of spreading supporting materials on top of the grids. The possible supporting materials may be straw, wood shavings, oxide nodules, or cheap hessian of a very open texture. Wood wool is an extremely bulky material and I have not seen it packaged in a compressed form. Oxide nodules while in themselves admirable from all viewpoints require time in preparation and take up storage space. Hessian is expensive—that is, unless an unlimited quantity of open weave sacks are available.

From the engineering viewpoint straw is an ideal material; it is light, has a good covering power, and is cheap. Unfortunately, it has one severe drawback which may preclude its use. Before dealing with this fault it would be as well to consider the amount of oxide that falls through grids even when straw is used.

A box 40 ft. × 40 ft. with 9 in. clearance beneath the grids has been found to hold five tons of oxide. Assuming a bulk density of 60 cu.ft. per ton, this gives a reduction of 25% free space beneath the box. The snag is that this amount of oxide can readily stop up the drains and bring the troubles inherent with bad drainage.

The first occasion on which I was associated with any trouble caused by straw was when a new box went to work. The top layer was 40-50 tons of new oxide, the bottom layer containing 40-50 tons of new oxide.

Almost immediately after it had been put in line, it commenced to evolve H_2S when in the position of last taker, this despite the fact that there were two clean boxes in front of it, and on test its own top layer showed no trace of H_2S when tested. The possibility of valve leakage was negated by the fact that the gas was tested from a position beneath the grids. The drains were functioning normally. The gas flow was of the order of 150,000 cu.ft. per hour and the H_2S evolved was greater than that specified by the Referees' test. In view of this it was decided to take the box out of line and examine it.

When the lids were removed the box appeared normal in all respects. There was no indication of channelling, so it was decided to dig down in the centre of each quarter. Nothing unusual was observed. The grids were clean and there was no oxide on the floor of the box which might have impeded drainage. Samples were taken of the oxide, and as an afterthought a sample of the straw which lay upon the bottom grids was taken. It was decided to pass clean purified gas through the various oxide samples and through the straw. The oxide did nothing peculiar but the straw evolved H_2S in quantity. The amount of straw taken for test was about 20 grammes.

Subsequent investigation showed that some of the straw used had been picked up at random over the works, and in consequence could be regarded as soiled material. In view of this information the box was emptied, new clean straw was used, and the box was put back to work. The box worked satisfactorily, and no H_2S was evolved.

Occasionally at Bradford, where it is the practice to use straw in boxes, we have a box which throws off H_2S, not, I am glad to say, in any quantity approaching that which we had with the box just described, but sufficient to cause some concern.

* Paper to the Yorkshire Junior Gas Association, February 8, 1950.

Recently we had a box which behaved in an identical manner, evolving H_2S at the bottom layer when the previous boxes were clean. The box in question was a fresh box and when I tested it after it had been working for some five weeks I found that the quantity of H_2S evolved was equal to one-third of the amount of H_2S required to show on the standard Referees' test and that this amount kept fairly constant.

The position at Bradford is that in order to prevent oxide dropping through the grids we throw straw on top of the grids. In consequence of these preventable measures, we have evolution of H_2S, this being so serious on one occasion that the box was emptied. The inference from this is that straw can cause H_2S to be evolved and that fouled straw is particularly prone to this defect. Therefore it was decided to use clean straw and to stove the bales so that they could not be contaminated.

Test on Clean Straw

Recently I subjected some of this clean straw to test. I took about 50 grammes of straw from the centre of a bale, moistened it and placed it in a large flask. A current of coal gas washed free from any traces of H_2S by bubbling through two dresshel bottles containing lead acetate solution was passed over the straw. This gas was then passed through a G.L.C. H_2S apparatus, and the amount of H_2S evolved was determined. For the first 30 min. no appreciable amount of H_2S was evolved, then it started coming off in quantity considering the small amount of straw used. Once it had attained its peak it continued evolving H_2S at the same amount. When I increased or decreased the gas flow, I observed that the amount of H_2S evolved was constant over a given period of time—that is, the gas rate was not a factor determining the rate of evolution. It appeared that a given weight of straw evolved a given amount of H_2S in a given time.

It was apparent that this was a reaction caused by bacteria present in straw, living on some sulphur-containing substance in the straw or in the gas.

I then passed a current of air free from H_2S over the straw. The evolution of H_2S tailed off very rapidly; after one hour the amount evolved was exceedingly small (0.01 p.p.m.). Finally all evolution of H_2S ceased. I then passed gas over this same straw and found that there was no evolution of H_2S. The inference from this is that prolonged aeration is fatal to these bacteria.

To prove this I subjected some straw which was part of the sample used in the previous test and which had been in the dry atmosphere of the laboratory for some four days to test. I repeated the experiment using identical conditions and found that there was no evolution of H_2S. In view of this evidence, it was decided to aerate the straw that we would be using in our future boxes. This was accomplished by opening the requisite number of bales and spreading the straw on the lids of one box. The particular set of purifiers was well protected, and there was no danger of the straw becoming wet or soiled.

After three days I took a similar weighed sample of this aerated straw and subjected it to test. The evolution of H_2S had decreased considerably, being about one-third of the amount previously determined on the straw which was taken out of the centre of an unopened bale. I should mention at this point that I am refraining from quoting figures of the amount of H_2S evolved, as the figures only relate to the tests that I have carried out and bear no relation to the figures obtained when a box throws off H_2S due to this cause.

The conclusion reached from these tests was that aeration of the straw retarded or completely prevented H_2S evolution.

Temperature a Vital Factor

The above tests had been carried out at room temperature —*i.e.*, about 60°F. I then took a fresh sample of straw from an opened bale and preheated the gas before passing it over the straw. The results showed that temperature was a vital factor. The H_2S evolved increased with a rise of temperature, reaching a maximum at 90°F.; unfortunately, a temperature very near that at which most boxes work. Above this temperature evolution decreased, finally stopping when the temperature reached 120°F. I allowed the straw to cool and tested again for H_2S at room temperature. There was no evolution of H_2S. The inference from this is that temperatures above 90°F. were harmful to the bacteria, and that they were killed. The conditions for treatment of straw that is to be used in purifiers, therefore, would be either to aerate the whole bale, or to store the bale in a hot place for, say, a few hours before use.

It was a very delightful theory to presume that the H_2S evolved had its source of sulphur in the sulphur compounds in the gas. Certainly all the evidence so far pointed to that assumption. Straw contains about 1-2% of sulphur. On our boxes we use about 150 lb. of straw per layer. That amount of sulphur—*i.e.*, 1 or 2 lb.—would not account for evolution of H_2S for weeks in quantity from a box dealing with 150,000 cu.ft. of gas per hour. This amount of sulphur would be sufficient to give a stain equivalent to one Referee test for 1½ days at the above gas rate. It is obviously not sufficient to cause contamination for weeks. I felt that the source of sulphur was to be found in the gas.

A number of further tests using different gases—*viz.*, town gas and water gas—failed to substantiate this hypothesis, the amount of H_2S remained the same. The only thing I noticed was that some samples evolved H_2S more freely than other samples, and that the straw required to be wet before H_2S evolution occurred.

I then decided to pass an inert gas over the straw. Clean straw was moistened and gas free from H_2S passed over; evolution of H_2S occurred after the preliminary period. Then a current of carbon dioxide free from H_2S was passed over the straw. It was found that the H_2S evolution remained constant and was the same concentration as when gas was passed over it. The concentration of H_2S did not tail off as it did when air was passed over straw.

Cause of H_2S Evolution

It was now apparent that H_2S evolution is caused by anaerobic bacteria that probably obtain their source of oxygen from the SO_4 radicle. It has been known for some time that these sulphur bacteria are responsible for H_2S evolution in holder water. They have caused considerable trouble by suddenly evolving H_2S in quantity. One has been isolated which lives on the SO_4 radicle and which can be easily grown on a medium of pH_4SO_4, and phosphate in water.

Bearing this in mind, I took a strip of hessian, moistened it, and passed clean gas over it for some hours. There was no evolution of the H_2S, a fact that is not surprising since hessian is processed before it is woven. Then two pieces of hessian cut from the piece tested were treated with ammonium sulphate and iron sulphate respectively, and allowed partially to dry out. Straw had been previously stood in a beaker of distilled water overnight. The strips of hessian were then moistened with this water and put under test. In both cases H_2S was evolved, not in such quantity as when straw alone was tested, but then the extract of bacteria was not the best obtainable.

This would seem to be the answer to the question of the amount of H_2S evolved from the box. The bacteria live upon the sulphates in the straw, and also upon the sulphates present in the box. The fact that evolution of H_2S eventually ceases is probably due either to naphthalene acting as a poison or to their own waste products poisoning them. Of all the materials tested only straw itself evolved H_2S.

In conclusion I would like to emphasise that whereas straw is probably the best auxiliary supporting material, it should be well aerated or left at a temperature of, say, 100°-120°F. for some hours before use. Either method results in the killing of the bacteria, although heating is certainly the better. Treatment with a good bactericide would also appear to be a logical suggestion. The straw could be sprayed with a weak solution of mercuric chloride, copper sulphate, or a phenol, after it has been spread over the grids.

PRESSURE HOLDER INSTALLATIONS*

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This paper is divided into two self-contained parts, the first consisting of a general discussion of pressure holder installations and the economic considerations governing their operation, the second consisting of a discussion of the engineering principles involved in the design, fabrication and erection of pressure holders. This division is significant and reflects the authors' opinion that while the gas engineer may be primarily interested in the application and in the economic aspects of the problem he should, at the same time, be aware of the engineering achievements arising from the advanced technique which has made possible the construction of large pressure holders. Such fabrication of large pressure vessels at site is an important step forward from the construction of steam boilers and small shop fabricated pressure vessels and represents an advance from the established codes of practice into a region not as yet exhaustively studied.

THE distribution of gas at high pressure is no new thing. For example, in Germany there has been for many years a high pressure distribution system for coke oven gas, and natural gas is pumped over long distances at high pressure in North America. However, these systems usually employ conventional low pressure storage. This paper is concerned with the development and use of high pressure storage systems in which the subsequent distribution may or may not be at high pressure. For the purpose of this paper high pressure covers the region from about 40 to 200 lb./sq. in. gauge.

Although storage and distribution schemes are usually designed with due regard to possible future requirements, it often happens that after some time an unforeseen demand occurs for which the system is found to be inadequate. In many cases increased mains capacity has been obtained by increasing the pressure. Thus when Beckton gasworks first took its place as the world's largest works a few inches W.G. sufficed for distribution, but to-day the pressures are measured in pounds per square inch gauge, although the bulk of the storage capacity remains at low pressure. Furthermore there are limits set to the possible increase in pressure by the tightness of the joints in the mains and ultimately by the costs of pumping. It should also be noted that as a distribution system becomes increasingly overloaded it becomes progressively more difficult to cope with the problem of peak load.

Application of Pressure Storage Installations

The economic aspects of the problem are discussed in more detail later in the paper but the results are mentioned at this stage to maintain the proper perspective. Pressure holder installations are not a cure for all storage and distribution troubles and the field is, in general, limited to:—

(i) Works storage in certain abnormal conditions.
(ii) Reinforcement and peak load supplies.

Pressure storage for the make can rarely be justified, but a case may be made out if space is extremely restricted. For example, a vertical cylindrical holder was erected at Buenos Aires (however, vertical cylinders are not suitable for conditions in cases where hydraulic testing is employed) and the late G. M. Gill, of the Severn Valley Group, installed some small pressure holder installations on the works,[1] in one case taking the whole make, as a temporary measure. Not all pressure holders situated on works sites are used for the make, in fact most of them are used for part-time reinforcement of the supply.

By far the most important application of pressure holder installations is the relief of peak load problems or part-time reinforcement of supply. At first sight it may be thought that the economic problem is simply a balance between the prime and annual costs of low and high pressure installations. In fact this simple balance would be appropriate only in considering straightforward works storage problems. The peak load problem is usually more complex and several possible solutions must be considered. For example, the solutions might be:—

(i) A new main of greater capacity.
(ii) Increased pressure in existing main by works boosters.
(iii) A low pressure holder at consumer's end of existing main to be filled at off-peak periods.
(iv) A ring main system with or without storage capacity.
(v) A high pressure storage installation.

It is at once clear that no general rules can be laid down and each scheme must be considered as need arises.

It has been suggested that the best way to exploit pressure storage is to use small holders installed seriatim to meet a gradually increasing load and then when the load is sufficient to warrant the installation of a large low pressure holder to use the pressure holders at a new site. Gill[1] also mentions a pressure holder installation being moved from one site to another.

Technical Advantages of a High Pressure Holder

There are no moving parts to a high pressure holder, and as no water is involved there is no wind and water line, and there is no need to take anti-freeze precautions. The internal surface of a pressure holder soon becomes filmed with oil which provides surface protection and corrosion is negligible. The smaller external surface reduces painting costs when compared with a low pressure holder of the same capacity. Finally gas from a pressure holder is largely dehydrated by virtue of having been compressed; gas saturated at 15°C, compressed to 5 atm., cooled to 15°C and re-expanded to about atmospheric pressure has a dewpoint below 0°C and is, for all practical purposes, dry gas.

All these advantages contribute to low cost of maintenance by comparison with a low pressure holder of equivalent storage capacity, and it is usual to assess maintenance charges for high pressure holders at half the rate used for low pressure holders.

Choice of Working Pressure

This problem may be approached in two ways, first by considering the plate thickness of the vessel, and second by considering the optimum pressure, based on type, initial cost, and running cost of the compressors. For high capacity holders, say 200,000 cu.ft. to 500,000 cu.ft. releasable capacity, it is found that 70/80 lb./sq. in. is suitable in that it gives a 25 ft. diameter holder with a plate thickness close to the maximum thickness that can be worked conveniently. With capacities of 100,000 cu.ft. or less a pressure of 100 lb./sq. in. is more suitable and in a few cases 200 lb/ sq. in. has been found to be the optimum.

From the compression point of view 80 lb./sq. in. is suitable and about the maximum for single stage compression in the range 20,000 cu.ft. per hour to 50,000 cu.ft. per hour. Therefore for big holders the best proposition under present conditions is to aim at 70/80 lb. sq. in. gauge as the working pressure. With the smaller holders at 100 lb./sq. in. the compressors will usually be two-stage, although for small units

* Paper to the Scottish Junior Gas Association (Western District), January 13, 1950, Royal Technical College, Glasgow.

it may be worth while to employ single-stage units. Two-stage compression is required in all cases where the working pressure is 200 lb./ sq. in.

The above figures show that pressures below about 5 atm. do not usually result in the cheapest installation, but there may be exceptions. For example, suppose that compressor capacity at 50 lb./sq. in. already existed, then the cheapest installation might well be a holder with a working pressure of 50 lb./ sq. in. as no provision need be made for compressors. Finally it should be pointed out that it is not necessarily true that the cheapest holder will give the cheapest complete installation.

Compressor Capacity

The compressor capacity required is related to the frequency and duration of the peak load and the amount of gas available at off-peak times. Thus for a daily peak load there may be only a few hours available for pumping gas which is available in excess of the normal demand. For example, suppose that the peak load maximum is 80,000 cu.ft. per day and that excess gas is available between 7 p.m. and 5 a.m. The maximum amount available may be 12,000 cu.ft. per hour. A compressor capacity of 12,000 cu.ft. per hour would be suitable, and taking account of the hours when the available gas does not amount to 12,000 cu.ft. the holder or holders could be filled between 7 p.m. and 5 a.m.

On the other hand consider a small outlying village where there is a short peak period for Sunday cooking amounting to 20,000 cu.ft., in which case excess gas will probably be available each night and a 1,000 cu.ft. per hour compressor will suffice to recharge the holder during the night times in the week.

Type of Compressor

In a pressure holder installation the pressure at the outlet of the compressors varies, increasing as the holder fills; and this variation in outlet pressure is one of the principal reasons for the choice of reciprocating machines, for this type gives the highest average efficiency over the pressure ranges involved. The various types of rotary compressors are somewhat less efficient and furthermore are usually more expensive. The compressors are usually run at substantially constant speed (any variation being that imposed by a small change in speed of the prime mover with changing load) and any complications inherent in speed control devices are avoided.

According to pressure and capacity the compressors may be single stage or double stage, single acting or double acting, air-cooled or water-cooled. In general, single stage compressors may be used for sizes up to 50,000 cu.ft. per hour at pressure up to 80 lb./sq. in. and up to 5,000 cu.ft. per hour at 100 lb./sq in. For higher capacities at these pressures and any capacity at higher pressures it is usual to use two-stage compressors. However, these limits are not rigid and the choice is, as it is in the cases of the other alternatives, often governed by availability of the compressors. In general double acting compressors are cheaper than single acting compressors and they have a slightly lower power consumption. The main consideration here is what happens to gas that leaks from the cylinders. Double acting compressors are commonly designed in such a manner that any escape is into the atmosphere whereas with most single acting machines the leaking gas goes into the crankcase. While in no way implying that reciprocating compressors leak noticeably such an occurrence must be kept in mind. To obviate the possibility of trouble from this source in the cases where gas gets into the crankcase it is not unusual to lead a pipe fitted with a relief valve to a place of safety outside the compressor house and at the same time fit special glands where the crankshaft passes through the crankcase.

Air cooled compressors are attractive by virtue of their simplicity but they are unsuitable for town gas compression except in small capacities at moderate pressure. In most cases the temperature rise would be considered excessive. For example, a single stage compressor of 3,000 cu.ft. per hour capacity at 100 lb./sq in., may reach a cylinder temperature of 450°F. This figure is reduced to under 300°F with a two-stage machine with efficient inter-stage cooling. Most compressors used in pressure storage installations are therefore water cooled.

The compressors used range in speed from 200 to 500 R.P.M. and, in the small sizes up to 800 R.P.M. The electric motor is the commonest form of motive power and is particularly suited to automatic control. If D.C. only is available compound motors wound to give a high starting torque are used, and in the more common case of A.C. supply either squirrel cage or slipring induction motors are used. The degree of protection of electric motors is discussed later when considering the design of compressor houses. Motors may be direct coupled to the compressors through a flexible coupling when a motor with the required compressor speed is available; in other cases a high speed motor with V-belt drive may be used.

Other sources of power which may be used alone or as standby alternatives are gas engines, diesel engines, steam engines. None of these is quite so well adapted to automatic control as the electric motor but all are worth considering for standby purposes.

Power Consumption

The compressor makers usually quote shaft H.P. at full load and recommend the next largest size of motor for direct drive. Suitable allowances must of course be made for belt drives for compressors running at less than motor-speed. It will be appreciated that the working load varies, increasing as the pressure in the holder increases. Therefore some allowance must be made for this variation in assessing power consumption and it can be done by taking the average figure for the operation of filling the vessel from its minimum pressure to its maximum working pressure. This average is about 72% of full load horsepower both for single and double stage compressors.

The calculation of power consumption is illustrated by the following calculation, for D.C. and for A.C. when charged for by consumption in kW.

Assume that the shaft horsepower at full load = 20
with a V-belt drive horsepower of motor at full load = 22
Motor size 25 H.P.

Assuming the motor efficiency is 90% the full load kW will be $\frac{22 \times 0.746}{0.9}$

Using the factor of 0.72 the average consumption will be $\frac{22 \times 0.746 \times 0.72}{0.9}$ which gives 13.1 kW.

For approximate calculations the factor of $\frac{0.746 \times 0.72}{0.9}$ may be taken as 0.6

—and for A.C. charged for by consumption in kVa the calculation is similar but includes a power factor correction. If this is 0.85 then full load kVa will be $22 \times \frac{0.746}{0.9 \times 0.85}$ and the average consumption will be $22 \times \frac{0.746}{0.9 \times 0.85} \times 0.72 = 15.4$ kVa and for approximate calculations the factor $\frac{0.746}{0.9 \times 0.85} \times 0.72 = 0.7$

Standby

As with most gasworks plant it is desirable to have standby units so that a continuous service of gas to the consumers is maintained. The proportion of standby plant in pressure holder installations will vary according to the size and with the duty which has to be performed. For example, several of the small installations put in the Severn Valley Group by Gill were without standby, and it was pointed out by Gill[1] (in answer to a question) that the risks did not warrant the

expense of standby. Apart from very small installations it is desirable to have standby.

Considering first the holders. There is nothing much that can go wrong with a holder, but the insurance company will want to carry out an internal examination at periodic intervals, and if only one holder is installed then the examination will have to be carried out during an off-peak time. If the peak load is a daily occurrence this may prove difficult and therefore the provision of two or more holders may be desirable. This does not mean that it is essential that they are all installed at once. Indeed in many cases they may be installed at intervals bearing a relationship to the periods between internal examinations carried out by the insurance companies.

Turning now to the compressing plant, there are two considerations which arise, first, there is the standby compressor capacity and, second, it is sometimes essential to have an alternative source of power to drive the compressors. Standby compressor capacity is installed, for example, by having two compressors each capable of handling the load or in large installations having two or more compressors working with one unit as standby. Alternative power units are not so general but the possibility of power failures cannot be ruled out.

Safety of Electrical Apparatus

It must be assumed that compressors may at some time allow gas to escape and that explosive mixtures may thereby be formed. Chance ignition of such a mixture must be reduced to negligible proportion by using safe apparatus as described in British Standard Specifications and in the Electricity Regulations.

For the present purpose there are two methods which are employed. First all motors and ancillary equipment may be of approved flameproof construction, but such equipment is expensive and, in many cases, is not so readily obtainable. The alternative solution is to isolate the compressors from the electrical equipment and this may be done by putting all the electrical equipment in a separate compartment and taking the driving shaft for the compressors through a flameproof stuffing box in the partition wall as shown in Fig. 1. Provided such a compartment is or may be made available this solution is usually the cheapest.

The normal fittings on a pressure holder are manholes, ladder and platforms for inspection purposes, one or more pressure relief valves, one or more drain valves, inlet and outlet valves (or one valve on a common inlet/outlet connection), pressure gauge and thermometer.

Relief valves are discussed separately later in the paper and the other fittings are standard items which do not call for particular comment; however, it is worth noting that the two types of gas valve usually considered for this application are:

(i) Lubricated plug type
(ii) Double faced valves.

On large pressure holders the external ladder may with advantage be of the moving type, which, in addition to giving access to the platform, aids external inspection and painting.

Relief Valves and Loss of Gas

Most pressure holders installed to date have been fitted with spring loaded relief valves identical to or similar to those used on steam boilers. Recently, however, the B.H.B. relay type of valve has been put on the market by W. C. Holmes which, it is claimed, reduces the wastage of gas that occurs when the relief valve operates. However most insurance companies require two of these B.H.B. valves per vessel and the cost of this system of relief valves is considerably greater than that of spring loaded relief valves (where in most cases the insurance companies are satisfied with one such valve).

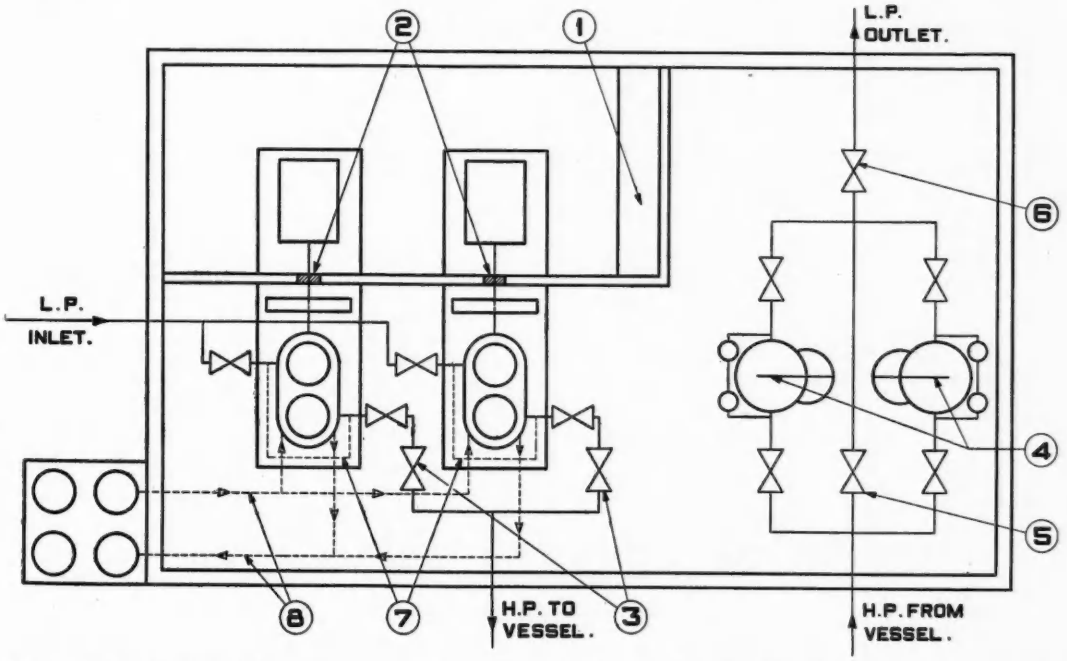

Fig. 1.—Typical layout of compressing gear and governors. 1.—Panel (Controls might be (a) to start compressor when low pressure inlet is above datum line; (b) to stop compressor when low pressure inlet is below datum line; (c) to stop compressor when the vessel is at maximum working pressure; (d) clock control; (e) working compressor selector). 2.—Flame-proof stuffing box. 3.—Non-return valve. 4.—Duplicate district governor. 5.—Governor by-pass valve. 6.—Discharge control valve. 7.—Compressor pressure relief lines. 8.—Cooling water lines.

The size of relief valve is governed by the maximum rate at which compressed gas can enter the holder. The relief valve must be able to pass out this volume and comply with the regulations contained in the appropriate British Standard Specification B.S.1500 (1949) (Provisional) which states that

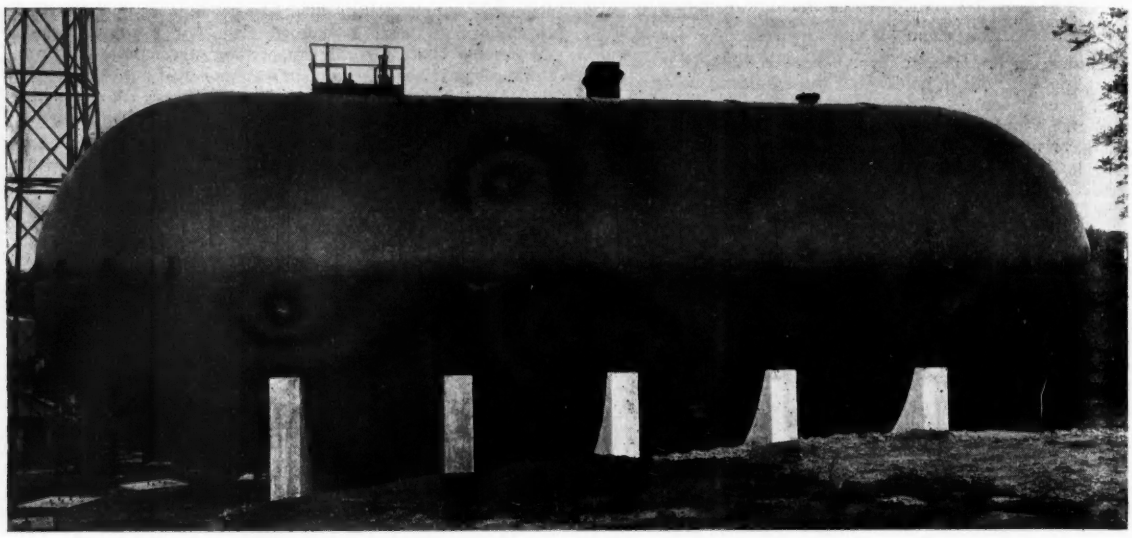

Fig. 2.—Whessoe horizontal cylindrical high pressure holder installed for the East Wight undertaking, Shanklin. The holder has a diameter of 30 ft. and an overall length of 85 ft. The operating pressure covers a range of 50 to 10 p.s.i.g., giving a releasable capacity of 150,000 cu.ft. This holder was site welded, hydraulically tested, and X-ray examined.

the relief valve must pass the gas out without causing a rise of pressure within the vessel exceeding 10% of the design pressure.

The relief valve is set to blow at the design pressure, which is usually 10% above the maximum working pressure, as this margin is sufficient to allow for all but the most exceptional temperature fluctuations. For example, a holder with gas at 80 lb./sq. in. gauge would need a temperature rise of 44°F to increase the pressure by 10%, while if the pressure were 200 lb./sq. in. the temperature rise to increase the pressure by 10% would be 48°F. It is safe to say that the chance of losing gas as a result of temperature fluctuations is remote.

The only other cause which will bring the relief valve into operation is the failure of the compressors to stop when the maximum working pressure is reached. The usual arrangements for automatically stopping the compressors when the working pressure is reached are robust and unlikely to fail in practice, and again it may be said that the chances of losing gas are remote.

However, it is worth considering for a moment how much gas will be lost if the relief valve does operate. The amount depends upon what is known in the steam world as 'blow down pressure' and is the difference between the pressure at which the valve blows and the pressure at which the valve becomes tight again after blowing. The closer the correspondence between opening and closing pressure the smaller the amount of gas that will be lost. This blow-down pressure varies with the make and type of relief valve from 1% to 10% (of gauge pressure). One of the main points in favour of the B.H.B. valve is its low blow-down pressure.

It is often suggested that the 'lost gas' could be saved by passing it back to the low pressure supply main. However, if this is attempted it must be remembered that: (1) The volume of gas so passed back will be considerable if the compressor fails to stop and may be beyond the capacity of the main at its normal pressure and seals might be blown and governors injured. (2) The relief valve connected to the low pressure side must be set below design pressure because it is necessary to have a relief valve set at design pressure and open to the atmosphere. Although such a scheme for avoiding loss of gas seems attractive at first sight the disadvantages caused by dissipation of the gas on the low pressure side of the installation often outweigh the value of the saved gas.

Another question which arises concerns the servicing of relief valves. In order to service a relief valve it is desirable to isolate it from the vessel which it controls, and contractors are sometimes asked to provide a stop valve between the relief valve and the vessel. This practice is not to be recommended —indeed, it is undesirable. The regulations relating to the interposition of a stop valve between the relief valve and the vessel are stringent, for it is obviously undesirable that the relief valve should be isolated inadvertently. Two methods of installation may meet with the approval of the Insurance Companies. First the stop valve may be padlocked and the key held by a responsible person. Second a special valve and two relief valves may be so connected that one or other of the relief valves is always connected to the receiver (*e.g.*, the Hopkinson 'Duoflow' valve performs this function).

Compressors and Governor Fittings and Controls

It is convenient to consider the compressing equipment and the governors together as they are commonly associated in the compressor house. In spite of proper equipment and full attention to maintenance, it must be assumed that a compressor house is a potential source of an explosive mixture and that electrical gear must be either flameproof or transferred to a more suitable position. As mentioned elsewhere the choice of method depends on particular conditions of site, price, and delivery.

The equipment of a typical compressor house is shown diagrammatically in Fig. 1 which illustrates the arrangement by which the electrical gear is separated from the compressors and the driving shafts pass through flameproof stuffing boxes in the partition wall.

1. Panel. Typical automatic controls might be
   - A. To start compressor when L.P. inlet above datum value.
   - B. To stop compressor when L.P. inlet below datum value.
   - C. To stop compressor when vessel at maximum working pressure.
   - D. Clock control.
   - E. Working compressor selector.
2. Flame-proof stuffing box.
3. Non-return valve.
4. Duplicate district governor.
5. Governor by-pass valve.
6. Discharge control valve.
7. Compressor pressure relief lines.
8. Cooling water lines.

The non-return valves prevent gas from the holder travelling back and passing through the compressors to the low pressure

inlet main. The discharge control valve is used to prevent simultaneous charging of the vessel by the compressors and discharging of the gas through the governors. If no such arrangement were made it would be possible (indeed, extremely probable) for the pulsations caused by the compressors to upset the functioning of the governors and cause pulsations in the distribution system. There are several ways of achieving this control. For example a solenoid operated valve may be energised to keep the valve closed when the compressors are running, or an oil operated valve may be maintained in the closed position by the pressure in the compressor lubricating system when the compressor is running. Another method is to take an impulse line from the inlet side of the compressors to a subsidiary governor on the outlet of the main governor so that when the compressor starts the subsidiary governor prevents the flow of gas to the distribution system. The manipulation of governors for purpose of automatic control of distribution is discussed in detail in the recent paper 'Gas Distribution—Modern Methods of Control' by Aiken and Stone (see bibliography).

The other features numbered in Fig. 1 do not call for particular comment as standard instruments, governors, and electrical apparatus are available. However, Fig 1 does not exhaust all the possibilities and there are a few additional features which contribute to successful and trouble-free operation. It is common practice to fit filters at the inlet to the compressors and the inlet to the governors. If the compressor station is adjacent to dwelling places it may be worth while fitting silencers at the outlet of the compressors. In Fig. 1 the water cooling tanks are shown outside the house, but some engineers prefer to have them inside the house so that there is less likelihood of trouble due to freezing.

In order to prevent damage occurring to compressors as a result of overheating a thermostatic device is installed on the water outlet from the compressor jacket which stops the compressors if the jacket water temperature exceeds its safe maximum figure.

Interconnecting Pipework and Mains

One of the more obvious advantages of gas distribution at high pressures is that mains of small diameter may be used and the appropriate size of mains to use may be calculated from Unwin's formula. The interconnecting pipework in the compressor house and between the vessel or vessels and the compressors is all calculated in the same way.

Jointing materials already familiar to gas engineers are used. For flanged joints a very successful packing is a Taylor ring consisting of asbestos within thin corrugated copper. Where adjustments are necessary socketed joints with lead wool are satisfactory.

The decision whether to have separate inlet and outlet connections or one common main is mainly a matter of convenience, and unless there is a good reason for not doing so it is recommended that a common main is used. One case in which it may be undesirable to have a common main arises in works storage where liquid carried forward in the inlet gas may be condensed in the common main and from there find its way to the outlet governors and interfere with their functioning.

Remote Indication and Control

Recent years have seen great advances in the technique of remote indication and control. As far as pressure holder installations are concerned the variables to be recorded are pressures (in passing it should be noted that the pressure of the gas in the holder is a measure of the stock) and perhaps temperatures, and in large installations it may be desirable to indicate flow rates. Control requirements are almost invariably electrical for starting or stopping motors on compressors, valves, &c.

Several systems are available which transmit the electrical impulses over telephone wires rented from the P.M.G.—*e.g.*, Elliott-Shotter and Automatic Telephone & Electric Co., Ltd. (see references in bibliography). A highly accurate method for shorter distances is the 'Selsyn' system employing coupled electric motors, but this requires the same supply of alternating current at holder and at indicating and/or controlling point and 3-phase interconnection and between the holder and the indicating and/or controlling station.

Prime and Annual Costs

The following items must be taken into account in determining the prime cost of a pressure holder installation.

1. Acquisition of site, including legal expenses.
2. Cost of foundations for holder or holders.
3. Cost of holders, including erection and testing, and insurance fees in connection with installation.
4. Cost of compressing equipment and interconnecting mains.
5. Cost of compressor house.

The details of the determination of the annual cost of a

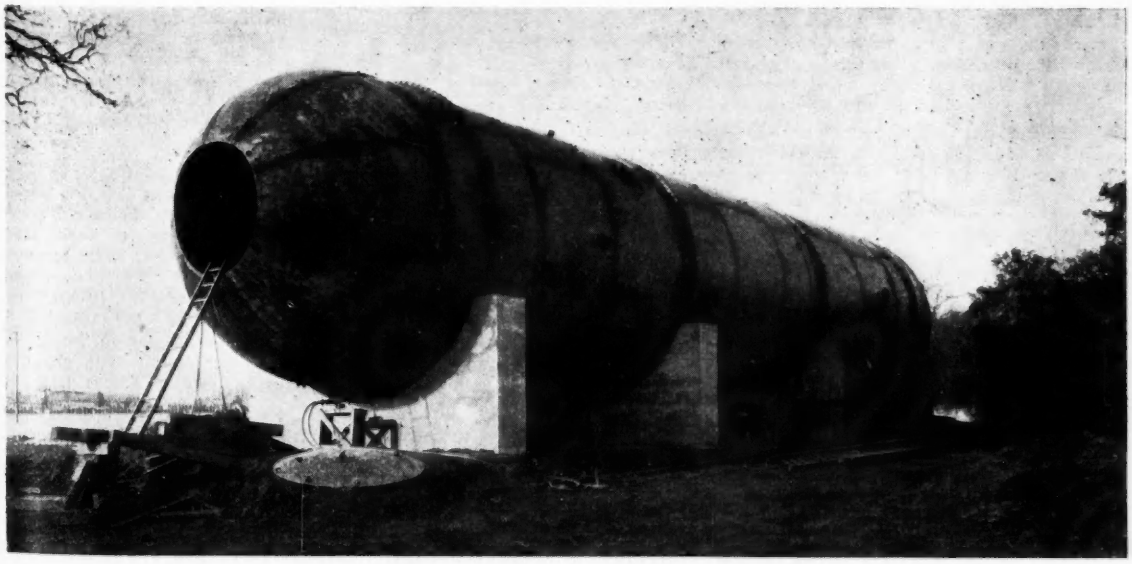

Fig. 3.—Whessoe site welded pressure holder at Wythall, 15 ft. diameter by 75 ft. overall length. This view illustrates the ball race method (patent applied for) of rotating the vessel to permit downhand welding of most joints. Conditions for welding internally are improved by the cap plates of the hemispherical ends being welded in last.

pressure holder installation will vary comewhat according to the method of providing for the prime cost, and also according to the method of depreciation used and the assumed economic life of the holders and the compressors.

Under the Gas Act, 1948, the methods of accountancy used in calculating depreciation and the basis of calculation of economic life of plant are to be decided by the Gas Council and will be subject to the approval of the Treasury. During the Report Stage of the Bill the possibility of differing methods being used by various area boards was raised and the Minister of Fuel & Power thought that the question was best left to the discretion of the Chairman of the Gas Council.

In S.38 of the Act it is laid down that, subject to the consent of the Minister and with the approval of the Treasury, money for working may be raised:—

(a) Temporarily by overdraft—for each area board and the Gas Council.

(b) By the issue of British Gas Stock by the Gas Council.

In S.40 it is laid down that Gas Stock may be (among other things) redeemed under schemes similar to those now in use for local authority stock.

S.46 makes it clear that the area boards and the Gas Council shall make proper provision for the redemption of capital and for depreciation and renewals of assets.

Now British Gas Stock bears interest at 3% per annum and the Gas Council will expect the borrowers to pay back more than 3% in order to cover administrative costs. This is outlined in subsection 3 of S.41 of the Act.

The following example is taken to be a reasonable interpretation of the requirements.

Let prime cost be £C and residual value after economic life of L years be £c.

Then annual proportion of loan to be paid off will be $\frac{£C-c}{L}$

Taking interest to be paid at 3½% then at end of 1st year there will be required for (i) Interest £0.035C; (ii) Loan repayment $\frac{£C-c}{L}$

At end of 2nd year (i) $£0.035\left(C-\frac{C-c}{L}\right)$; (ii) $\frac{£C-c}{L}$

At end of 3rd year (i) $£0.035\left(C-\frac{2(C-c)}{L}\right)$; (ii) $\frac{£C-c}{L}$

and so on.

A numerical example:—Cost of plant (*i.e.*, loan) = £10,000. Residual value *nil*. Economic Life 10 yr. Interest payable on loan 3½%.

At end of	1st year.	Repayment	£1,000,	interest on	£10,000	at 3½%	=	350
» » »	2nd »	»	»	» »	9,000	»	=	315
» » »	3rd »	»	»	» »	8,000	»	=	280
» » »	4th »	»	»	» »	7,000	»	=	245
» » »	5th »	»	»	» »	6,000	»	=	210
» » »	6th »	»	»	» »	5,000	»	=	175
» » »	7th »	»	»	» »	4,000	»	=	140
» » »	8th »	»	»	» »	3,000	»	=	105
» » »	9th »	»	»	» »	2,000	»	=	70
» » »	10th »	»	»	» »	1,000	»	=	35
								£1,925

Thus annual average rate of interest = 1.925%.

It is clear that the annual average rate of interest will vary with the years. Table 1 shows the values for the 3½% rate.

TABLE 1.

Number of years economic life	Annual average rate of interest	Per cent. of loan paid off each year	Per cent. annual charges
5	2.10	20	22.1
10	1.925	10	11.9
15	1.86	6.67	8.5
20	1.84	5	6.8
25	1.82	4	5.8
30	1.80	3.33	5.1
40	1.79	2.5	4.3
50	1.785	2.0	3.8
Inf.	1.75	0	1.75

The annual average rate of interest is simply computed as half the sum of the first and last terms of an arithmetical progression of which the first term is the last increment of interest and the last term is the first increment of interest.

In determining the economic life of plant two aspects must be considered. First there is the probable life as envisaged by the engineer and the second the repayment term for loans generally approved (*e.g.*, in municipal finance). These terms are not necessarily the same. For example Escreet[2] took a period of 50 years as the time for depreciation of pressure holders, whereas a municipal loan on a gasholder was customarily repayable in 30 years.

For the purposes of this paper the following economic lives and scrap values have been assumed.

Holders and civil engineering work 50 years and *nil* scrap value.

Compressing equipment 15 years and 10% scrap value.

Renewals and maintenance have been taken as:—

Holders 0.5% per annum.

Compressors, &c., 2.5% per annum.

As far as the holder is concerned the only items likely to require renewing are the manhole joint rings after internal examination has been carried out and maintenance would be confined to painting the exterior of the vessel and servicing the relief valve. The compressor gear and motors will require the usual routine maintenance and, during their life, a few replacements.

The cost of supervision will vary according to the complexity of the installation, but with a fully automatic installation a weekly examination will probably suffice. At the weekly visit the following points should be watched:

1. The holders should be drained.
2. Compressor water system checked.
3. Lubrication attended to.
4. Charts changed.

In the examples below the cost of supervision has been taken at £30 per annum.

Thus the annual fixed costs amount to:—

Holders and civil engineering work	4½%
Compressing equipment	10%

For practical purposes of comparison of various possible schemes it is sufficient to take 10% of the cost of the compressing equipment and 4½% on the remainder of the cost of the installation to cover the annual fixed costs.

Thus the annual costs will comprise the following items:—

1. 10% of prime cost of compressing equipment.
2. 4½% of prime cost of remainder.
3. Insurance, supervision, &c.
4. Running costs of compressors.

Table 2 shows the annual costs of three pressure storage schemes. Scheme I comprises one shop welded vessel 10 ft. x 55 ft. 6 in. to work at 140 lb./sq. in., with releasable capacity 39,300 cu.ft. together with one 5,000 cu.ft. per hour compressor, giving a filling time of 8 hr. Separate columns of figures are given for 160 and 365 fillings respectively per annum. No standby compressor is included for this installation. In this respect Scheme I differs from Schemes 2 and 3 which have standby compressor capacity. Scheme 2 comprises one site-welded holder 25 ft. x 200 ft., to work at 80 lb./sq. in. with releasable capacity of 0.5 mill. cu.ft., together with two compressors each of 50,000 cu.ft. per hr., giving a filling time, with one compressor working, of 10 hr. The number of fillings is taken as 160 or 365 as before. Scheme 3 comprises five holders each similar to the one in Scheme 2, four compressors (three working with one standby), giving a filling time of 6.7 hr., and the number of fillings taken is again 160 or 365.

Insurance

A water-sealed holder of which the storage capacity exceeds 5,000 cu.ft. is a 'factory' under the Factories Act, 1937, S.151 (1) (XIII) and there is a statutory requirement that the holder shall be examined periodically by a 'competent person.' No definition of a competent person is essayed in the Act and a suitably experienced and qualified employee may perform the statutory inspection. A pressure holder should be examined in the same manner.

TABLE 2.

ANNUAL COSTS.

	Scheme 1				Scheme 2				Scheme 3			
Number of vessels	1				1				5			
Total releasable capacity, cu.ft. ...	39,300				500,000				2,500,000			
Number of fillings per annum ...	160		365		160		365		160		365	
Charges :	£	%	£	%	£	%	£	%	£	%	£	%
1. Compressor sets ; capital charges, maintenance	236	38.1	236	32.0	1,050	28.3	1,050	23.6	3,300	22.0	3,300	18.5
2. Holders and civil engineering capital charges and maintenance	190	30.7	190	25.8	1,875	50.6	1,875	42.0	9,075	60.5	9,075	50.8
3. Miscellaneous and supervision ...	100	16.2	100	13.6	198	5.3	198	4.4	375	2.5	375	2.1
4 Running costs of compressors ...	93	15.0	211	28.6	587	15.8	1,340	30.0	2,250	15.0	5,100	28.6
5. Total	£619	100.0	£737	100.0	£3,710	100.0	£4,463	100.0	£15,000	100.0	£17,850	100.0

Prices based on 1948 costs, and electric power at 1d. per B.O.T. unit.

However, it is customary to employ the engineers and surveyors of an insurance company and at the same time insure the installation. The premiums for such insurance are calculated in the main on three factors—viz. (1) sum insured; (2) size and type of plant; (3) amount of inspection work involved. In a typical case the insurance cover is in two sections as follows: —

(i) Holders. (a) Damage to the holders themselves. (b) Damage to all surrounding property. (c) Legal liability for third party personal injury, all resulting directly from explosion.

(ii) Compressor Plant. (a) Electrical and/or mechanical breakdown. (b) Breakage and/or sudden overheating of bearings, all in respect of the cost of repair or replacement.

A considerable proportion of the premium is required to cover the cost of inspection and the proportion devoted to insurance is small, so small indeed that it can be neglected in calculations of annual costs. It seems that it is cheaper to insure a pressure holder than a motor car.

The frequency of examination may vary from one company to another but an external examination will be required at about two-yearly intervals and an internal examination (with, if thought necessary, a hydraulic test) at four-yearly intervals.

The principles of gas storage seem to divide themselves into two sharply defined categories.

(a) Storage at constant pressure and variable volume.

(b) Storage at constant volume and variable pressure.

Though this paper is entirely concerned with the latter type, time should be spared to pay tribute to the skill and endeavour that has gone to make the telescopic gasholder an engineering possibility of such wide usage.

High pressure gasholders which typify the second class are of more recent arrival. About them there remains much to be learned, for though their descent may be traced almost directly to steam boilers and air receivers, the very size of them introduces problems which could be ignored quite safely in their smaller ancestors.

The range of vessel in mind is from 7 ft. 6 in.-32 ft. diameter, 30 ft.-200 ft. long for cylinders, and 30 ft.-45 ft. diameter for spheres. The pressure range is from 40-200 lb./sq. in. though the maximum pressure and maximum diameter are not found in combination. Since this range is on the outside fringe of the present-day codes of practice, the engineer should proceed with caution and consider each problem carefully and with imagination.

Those responsible for compiling pressure vessel codes—for example, Associated Offices Technical Committee—are aware that there exist problems for which the present codes do not apply, and will no doubt take steps to fill the needs. But while industry is prepared to co-operate with such authorities, they cannot afford to be held back in progress pending the complete answer. On the other hand, it is not fair to expect these authorities to commit themselves to schemes which are to say the least novel.

Form of Pressure Holders

Invariably the pressure holder of today takes the form of either a sphere or a cylinder with dished or hemispherical ends, with axis disposed horizontally though occasionally vertically.

The spherical vessel is theoretically the ideal shape for containing gas under pressure. The shell is equally stressed in all directions and would be of thickness roughly half that of the shell of a cylinder of equal diameter. This would indicate an economy of material as compared with the cylinder, but due to the extra workmanship involved the final cost is usually in favour of the cylinder. Nevertheless, there are examples of this type of holder.

With prime cost in favour of the cylinder it is not unexpected that it should be the most common example of pressure storage vessel. There is another advantage in its favour—namely, ease of concealment. Engineers are not as a rule given to burying their works—in fact they show rather the reverse tendency—but in the case of the horizontal cylinder it is relatively easy to comply with the aesthetic whims of the public, if need be.

The authors can recall no examples in the British Isles of H.P. gasholders with their axes disposed vertically. The problems introduced would be somewhat more acute—for instance, water testing—but they are not by any way insuperable. It might be mentioned that the author's company is at present engaged in the construction of some pressure vessels for the catalyst cracking of petroleum. These large cylinders are arranged with their axes vertical—an essential feature of the process itself.

Riveted Construction

The design of riveted pressure holders follows British Standards requirements for air receivers, and their construction is based on good boilershop practice. The riveted joints of a large holder, however, present three problems which do not apply to air receivers. These problems are associated with size and the consequent necessity to assemble and rivet on foundations at site.

(1) The holder shell is relatively flexible because of its small thickness in relation to diameter. To ensure the permanent tightness of caulking it is therefore necessary to reduce the outer rivet pitch below that allowable for small vessels, and so to reduce the joint efficiency. It is undesirable to use a longitudinal double-butt strapped joint of more than 80% efficiency.

(2) The shop production of riveted joints centres on the ability of a hydraulic gap-riveting machine to close the plates fully as the rivet is driven. This type of riveting cannot be effectively applied to all joints of a site-built holder. With hand riveting (hand pneumatic riveting may not give the quality of workmanship required), there is a risk that joints are not effectively closed.

(3) Much of the riveting must be done at angles and under weather conditions not conducive to good workmanship. Boilershop standards are attainable only if there is a high degree of supervision of all stages of the work.

In addition, the supply of first class young riveters is becoming increasingly difficult, and the payment of wages such as to attract this skill would increase the erection costs of a larger holder.

The increasing difficulty in obtaining first class riveters combined with the advances made in the science and practice of welding has had repercussions throughout engineering. Pressure gasholders have not been in any way an exception. Confidence has been expressed by the A.O.T.C. in this relatively new method in rating the joint efficiency at 95% for the shop

built vessel, provided that the manufacturer takes advantage of the latest techniques in welding, X-ray examination, and weld rectification, and correct heat treatment for the relief of contraction stresses. All these procedures have been adopted with a view to making the finished vessel as near perfect as possible. Started in the shops, the time has not been long before all these measures, with the exception of stress relief, have crept into the field. Methods have had to be changed slightly and new equipment designed expressly for field work, but so far a practical solution for the complete stress relief of a large pressure holder at site has not come to light.

At present the A.O.T.C. will award to a field erected butt-welded vessel a joint efficiency of 67% or 72% according to the mechanical tests carried out on the welds. These figures increase to 77% and 82% if complete X-ray examination is conducted, and can be raised by a further 3% by dressing flush all the welded seams. Thus the best example of field welded pressure vessel will have a joint efficiency rated at 85%. The removal of the 10% deficiency between this figure and the 95% rating of the shop built vessel awaits the practical solution to the problem of site stress relief.

Bearing in mind the high standard of work required of the welder, every advantage should be given to him—even to the extent of ensuring that as much as possible of the work is carried out in the 'downhand' position, with the operator protected from the weather. Such precautions become a virtual necessity when advantage is being taken of the higher efficiency ratings offered by the X-ray proven joint. While the primary consideration to weld 'downhand' is favourable to the welder, there are other points equally of advantage. The position makes possible the introduction of the U-type of preparation, and the use of heavy gauge rods, both of which have an important bearing on weld quality and speed, while only in this position may the special rods designed for Class I welding be used (PV or Fleetweld 9).

It is important that the subject of pre-heating is not omitted. All thick plate must be heated until it is warm to the touch, if weld cracking is to be avoided. On cold mornings a considerable amount of heat is required, and is supplied in the form of multi-jet gas burners. Once work is well under way the heat conduction in the plate will suffice. In any case, welding must not be started when conditions of heavy frost persist, or until all sign of moisture on the seams to be welded have been removed.

Advances are not attained without effort. A 67% to 72% joint efficiency rating implies a high standard of welding achieved by careful supervision and expert training of welders. The use of X-ray as a quality control medium is becoming more widely realised. Applied to pressure vessels, erected in the field, 20-100 exposures are made depending upon the size of the vessel, and will have important psychological effects upon the welders. In the interpretation of the negatives a small amount of porosity is permitted, but all signs of cracks, lack of fusion, and large slag inclusions, call for repair and a possible extension of the survey.

Where the volume of high class welding is large it is recommended that special steps are taken to ensure a pool of highly qualified and able welders. The author's company has thought fit to start a welding school for the training of its own welders who show promise. The course is of two weeks' duration, and at any one time 14 welders can be accommodated in the charge of a former works Class I approved welder. Extensive use is made of X-ray in the examination of their work and it is found that roughly 50% of these men are able to reach the required standard in the fortnight. Though this course is not sufficient to convert the good welder into a Class I approved man, a few months further experience would be considered sufficient to fit a conscientious man to undertake the Lloyds Class I test.

Pressure Testing

The subject of pressure testing would take longer than the time available to discuss thoroughly. Two methods are used —namely, pneumatic and hydraulic tests, each of which suffer certain disadvantages.

During the air test, the pressure inside the vessel is raised to a figure 10%-20% in excess of the design pressure. At this stage a considerable quantity of potential energy is stored, sufficient to cause a disastrous explosion if a crack were started. The hydraulic test does not suffer this disadvantage of stored potential energy, and for this reason the pressure in the vessel can be raised to a figure 50%-100% in excess of the design pressure. At this stage, the material of which the vessel is fabricated is near its yield point, and a general redistribution of stress takes place, which is beneficial.

After giving close attention to the relative merits and demerits of the pressure test, the author's company has thought fit to advise the prospective client to accept the higher costs of the hydraulic test, with the knowledge that the test is safe.

Support

Relatively flexible vessels of the size dealt with in this paper, could not be called upon to support loads several times their own weight without due attention being paid to their behaviour. Continuous support of the vessel was discarded (in favour of intermittent support) on considerations of cost and the possibility of serious corrosion, and an investigation was undertaken of the stresses involved when a thin cylinder full of water was supported on a number of cradles along its length. Some conception of the problem will be given when it is stated that a certain vessel, weighing of itself 185 tons, successfully carried an additional weight of some 1,350 tons. of water.

During filling the cross section of the vessel changes shape from circular to elliptical, going through a critical state when about half full. However, when the test pressure is imposed upon the already full vessel the condition is far worse than the formerly mentioned critical state, and this in fact set the problem.

As an aid to the mathematical solution, two basic assumptions were made:—

(a) That over each support the vessel was so stiffened as to remain circular.
(b) That the supports were infinite in number so that the generators were horizontal over each support.

Even with these simplifying assumptions the mathematics was involved but eventually yielded a solution in the form of a series of curves giving the maximum plate stress against the pitch of supports for a range of diameters. The solution also yielded information relating to the load distribution in the stiffening rings, and gave a basis for their design.

On the basis of these facts it might be considered that the calculated stresses of the order of 13¼ tons/sq. in. under test conditions were somewhat high. The alternative was to design the vessel so that throughout the major part of its life it was working at a stress which was ridiculously low.

There are other duties which the supports are called upon to undertake. It was implied earlier that it was desirable, if not essential, that the vessel should be free to revolve about its axis so that all the seams in the barrel could be welded in the 'downhand' position. Further, the supports should provide for the longitudinal expansion of the holder consequent upon changes of the temperature of the shell.

An interesting patented solution combining these two advantages has been found in the use of what amounts to a 'ball race' on a very large scale, the balls being some 3¾ in. in diameter distributed around the circumference of the vessel at about 4½ in. pitch. A R.S. channel extending around the periphery forms the cage; on this provision must be made to take up any changes in length of circumference of the vessel, as the weld contraction takes place. After the completion of welding, the top arc of 240° is removed—being considered normal erection tackle—while the holder is secured against movement over one support.

At intervals during the life of a pressure holder the insurance company, which is often the inspection authority as well, requires to subject the vessel to further water test. It is felt that the vessel should withstand these tests without external aid in the form of timber packing or subsidiary steel support.

It was usual practice to prop the hemispherical ends of a cylinder. This was always felt to be an inherent weakness leaving room for human error. At no increase in cost, the ends can be made self supporting by a simple arrangement of internal girders welded to the shell of the hemisphere.

Fittings

Good pressure-holder practice, as regards the type and attachment of manholes and branches, is in line with that established for steam boilers and air receivers and meeting the requirements of the Factories Acts and Insurance Codes. For riveted construction, no special observations are here necessary.

Where the attachment of fittings is to be by welding, a realisation of the special problems involved is of first importance. Reference has been made earlier to the stresses set up and retained in welded joints. While in certain circumstances these may be accepted in straight butt joints, they constitute a distinct hazard in the case of heavy welds around manhole and branch compensating rings. At these points, even in a pressure vessel of riveted construction, there are high local stresses, but the shrinkage of heavy welds may set up additional stresses. This condition has during the past few years been found to be in part the origin of certain welded pressure-vessel explosions in the United States of America, and a subsequent examination of many installed vessels in that country has shown the existence of dangerous stress cracks.

It has been established that the welding of fittings to pressure vessel shells should be followed by stress relieving. In practice, therefore, the designer tries to locate the fittings all in one shell plate, or in as few plates as possible, so that a minimum number of plates with their fittings welded into position need be treated in a stress-relieving furnace. Research work on this particular problem under the auspices of the British Welding Research Association may lead to a reduction of the welds sizes in the vicinity of openings, &c., with corresponding reduction of risk.

Design

All the codes give formulæ for the determination of the shell thickness once the design pressure and vessel diameter have been settled. These formulæ are all based upon the thin plate theory for cylindrical and spherical vessels, but vary in form according to the units in which the variables are expressed, the factor of safety employed, and the separate corrosion allowance advocated. Nevertheless, as has been indicated earlier, no factor is introduced which would account for anything like the size of the vessel and the effect of proof test conditions.

The authors have attempted to give some small conception of the problems involved in building a high pressure gasholder. The finer points in the design and manufacture have been touched upon, and to complete the picture the reader is reminded that attention should be paid to the material which is ultimately to be shaped to form the vessel.

Here both designer and inspector play important parts; the former selects the proper material; the latter watches every stage of manufacture to ensure that the high standard of workmanship required is maintained throughout.

The authors are indebted to the Directors of Whessoe Limited, for permission to publish this paper. They would also like to express their appreciation for the help they have obtained from M. J. Noone, K. W. Francombe, R. F. Bishop, S. Little, I. Stout, and colleagues.

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This list of papers is in no way comprehensive but serves to show the extent to which pressure holder installations are being considered as economic in the gas industry.

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ACCIDENTS IN WORKS, 1949

Provisional figures published by the Ministry of Labour relating to industrial accidents during 1949 show that the total number of workpeople, other than seamen, whose deaths from accidents in the course of their employment were reported in the United Kingdom, was 1,508. Of this total, 520 occurred at mines and quarries, 786 at premises covered by the Factories Act, and 202 in the railway service. The figure of 786 deaths from notifiable accidents under the Factories Act compares favourably with a final figure of 861 in 1948. Thirty-four fatal accidents at gasworks were recorded last year. Statistics for industrial diseases reported last year under the Factories Act, 1947, or under the Lead Paint (Protection and Poisoning Act), 1926, give a provisional total of 459, of which 16 were fatal. This includes 140 cases of epitheliomatous ulceration, compared with a final figure of 233 for 1948, of which 13 were fatal. Ninety-two of the cases were due to pitch, against 112 —the highest recorded—in 1948, 72 to tar, against 87, and 28 to oil, against 146; no cases attributable to paraffin were reported, although there were 34 in 1948.

INDUSTRIAL DISPUTES

A preliminary examination of stoppages of work through disputes in 1949, undertaken by the Ministry of Labour, shows that 1,423 stoppages began in the year, involving 434,000 workers and resulting in the loss of 1,808,000 working days. Comparative figures for 1948 were 1,759 disputes, affecting 426,000 workers with a consequent loss of 1,944,000 days. Taking the figure for 1949, the Ministry of Labour claims that less than 2% of the total population in civil employment were involved in stoppages, the loss of time for the workers concerned averaging about five working days throughout the year. Coal mining was again the industry mainly affected by stoppages of work, there being 8,172 instances in that industry, on account of which 247,700 workers lost, in the aggregate, 754,000 working days.

In regard to wage movements and working hours during 1949, the Ministry of Labour estimates that over the year there was an aggregate increase of £1,073,700 a week in the full-time wages of 5,198,500 workers. This represents on the average a rise of between 1½% and 2% compared with 1948. The amount of the total wage increase, the Ministry says, was smaller than in any year since 1939. In many industries no general increases in rates of wages were reported, including the coal industry and engineering. One million people had their normal working hours reduced by about 1½ hours on the average in 1949, compared with 600,000 whose working week was reduced in 1948 and 5,200,000 who benefited by a reduction in hours in 1947.